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# China Report

## ECONOMIC AFFAIRS

No. 207

Energy: Status and Developments--III

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## ENERGY: STATUS AND DEVELOPMENTS--III

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# LOW RECOVERY RATE, FIRES, FLOODING PLAGUE MINING INDUSTRY

Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese, No 11, Nov 81 pp 2-7

[Article by Tong Youde [4547 2589 1795] and Ding Kun [0002 3540] of the Technological Commission of the Ministry of Coal Industry: "Views on Improving the Recovery Rate of Resources by Strengthening Mine Geology"]

[Text] I. Several Existing Problems of the Present Recovery Rate of Coal Resources

According to recent surveys and analyses of a fairly large number of mines, the recovery rate in ordinary mines is about 50 percent, horizontal recovery rate is about 60 percent, and the recovery rate in stopes is about 70 percent. The recovery rate at some mines is even lower, with the recovery rate of some individual mines reaching only 36.7 percent. Because the recovery rate of the mines is low, massive amounts of coal resources are lost, causing great damage and serious consequences.

1. The shortening of the number of years of service of the mines has created a gap in replacing mines and levels and increased the burden of building new mines. Some mines have a designed capacity of 1.2 million tons, but at present, preliminary estimates of their recovery rate is only 45.4 percent. Their number of years of service is estimated to be 62 years, 28 years less than the originally designed life of 90 years, short by one-third. This requires building new mines 28 years earlier to replace them. Some mines have a designed capacity of 450,000 tons and 35 years of service. During the ten years since they began production, 3.09 million tons of coal have been extracted from them and 11.02 million tons of reserves have already been used. Those mines will be exhausted within the next ten years and new mines must be built 15 years earlier to replace them. Again, for example, because of the low horizontal recovery rate at some mines, the number of years of service of levels has decreased considerably. The designed years of service of the first level of some mines was 20 years, but because of the low horizontal recovery rate, they served only 7.2 years, 12.8 years less than planned. Also, the designed years of service of the second level of some mines was 24 years, but because of the low horizontal recovery rate, they only served 9.6 years, 14.4 years less than planned. The number of years of service of all these mines has been shortened by two-thirds, creating a gap in the replacement of the levels.

2. Because of the low recovery rate, the tunneling rate increased, creating a gap between stoping and tunneling. Surveys of some of the uniformly equipped mines showed that the recovery rate in stopes of four-fifths of the mines did not reach the national standard, and each year, 880,000 more tons of coal were lost. Preliminary estimates showed this was equivalent to a waste of 10,000 meters in footage. The lower the recovery rate, the higher the tunneling rate. This causes tunneling to lag behind stoping, creates an imbalance between stoping and tunneling and seriously affects production.

3. Because of the low recovery rate, a lot of coal is lost, spontaneous combustion occurs easily and safe production is threatened. For example, at some mining bureaus, many spontaneous fires have occurred because of the low recovery rate and the large amounts of coal lost. At seven mines of those bureaus, fires occurred in 26 areas covering 4.58 million square meters. At one mine alone, 6.8 million tons of coal were inaccessible because of fires at the mine, seriously affecting safe production. Also, for example, an inclined shaft had lost a lot of coal and there was a lot of coal dust in the shaft. In 1975, a gas explosion caused a coal dust explosion, which increased the destruction and made the accident worse, bringing about serious results in safe production.

4. Because of the low recovery rate, large amounts of coal have been lost and massive economic losses have occurred. According to the preliminary analysis of economic loss caused by low recovery rates at the Kailuan Coal Mines, the Yangguan Mining Bureau and the Pingdingshan Mining Bureau, about 3 yuan of investment is needed to provide 1 ton of workable industrial reserve in a mine. The amount of investment needed to produce 1 ton of workable industrial reserve in southern mines is even higher. Taking the nation's uniformly equipped mines as an example, if the recovery rate drops by 1 percent, over 7 million tons more of industrial coal reserves and an investment of more than 21 million yuan would be lost.

Therefore, improving the recovery rate of coal resources in mines is indeed one of the pressing problems that urgently needs to be solved by the coal industry at present.

## II. Analysis of the Cause of Low Recovery Rates in Mines at Present

There are many causes of a low recovery rate. They involve many aspects of work such as geological surveying and prospecting, design of the mines, extraction techniques, geological measurements of the mines, and management of reserves. In particular, many effective technical measures and management systems that improve the recovery rate have been destroyed. Among the proportions of the loss in coal resources, the proportion of loss due to extraction is the largest. The reason is that the extraction methods are irrational. Some mining bureaus also use irregular coal mining methods of buttressing and leaving remnant columns. The recovery rate of these coal mining methods is generally about 30 percent. At some of the mining bureaus, there were 3 mines that used the buttressing method in 1975 and extracted 3,640,000 tons, a loss of nearly 700,000 tons of coal compared to regular coal mining methods, and the recovery rate is over 40 percent lower than that of regular coal mining methods. Also, for example, some mines left a false roof of a layer of coal in a 10-meter thick coal seam, and in 1976, the average recovery rate of the stopes was only 33 percent. There were also many mining bureaus that violated [proper] extraction procedures, mining the thick seams and abandoning the thin ones, and mining good quality coal and abandoning poor quality coal. For example, some mining bureaus completely abandoned any coal seams 1.3 meters thick, with unreasonable writeoffs of coal from thin coal seams going over 6 million tons, and the actual recovery rate of stopes in thin coal seams was only 34.9 percent. Another mine in one instance abandoned 1,050,000 tons of coal in a thin coal seam 0.9 meters thick. There was another mine that in one case abandoned a coal seam with a relatively high ash content, losing 600,000 tons of coal resources. In losses due to extraction, the proportion of loss to coal columns is also very large. Generally, this type of loss constitutes 30 percent to 40 percent of the total amount lost, with the highest reaching over 50 percent. Therefore, to improve the recovery rate, it is necessary to improve the method of coal extraction, mining techniques and the distribution of tunnels.

Poor geological work in mines is also an important reason that causes a low recovery rate. The main manifestation of this is that the proportion of geological loss at some mines is very large. On the other hand, some losses of coal resources seem to be losses in extraction but actually they are the results of problems in geological measurements and management of the reserves of the mines. For example, over a period of 14 years, some mines lost 4.69 million tons of coal resources simply because the tunnels did not reach the boundaries of the coal seams. That loss amounted to 4.6 percent of the worked reserve. At one mine, most of the coal cutting tunnels did not reach the boundaries of the seams, and from 1973 when it began production to the end of 1980, it had lost 1.29 million tons of coal, constituting 23.7 percent of the worked reserve, and the recovery rate of the mine was only 44.2 percent. Also for example, over a period of 14 years, some mining bureaus lost 3.82 million tons of coal deposits in the fault deltas [duanceng sanjiao 2451 1461 0005 3561] constituting 2 percent of the worked reserve. Many bureaus and mines were not strict in reviewing and approving writeoffs of reserves. Violations of mining procedures, tunneling that did not reach the boundaries of coal seams, abandoning thin coal seams and coal deposits in the fault deltas that could be mined were not included in calculations of the recovery rate, thus, the statistical recovery rate was higher but it did not reflect the actual recovery rate. Therefore, strengthening geological work in mines at present is also an important aspect to increase the recovery rate.

Some coal mines have accumulated a rich experience in strengthening geological work in mines to increase the recovery rate. The coal seams in some mines were more seriously damaged and the geological structures were complex, but because geological work in mines was strengthened, the tectonics were clearly understood, and [correct] measures were taken, more coal was mined and the recovery rate was increased. For example, the Tangjiazhuang Mine of the Kailuan Mines is situated in the eastern part of the Kaiping Coal Fields. The geological structure and the hydrogeological conditions are all very complex. Statistics of the 76 faces that had already been mined showed that a total of 1990 large and small faults had been encountered, an average of 27 faults in each face, but because geological work in the mines was strengthened, the geological structures of the coal seams were conscientiously surveyed and studied, the patterns of development of the coal seams and the faults were grasped, and more accurate predictions and judgments of the structure of the coal seams and the faults were made, corresponding technical measures were taken, and geological loss was reduced. Also, for example, the area of the 3007 stope on the northern wing of the C zone of the basin of the mine is only 160,000 square meters, but the coal seam is cut into two sections by three faults. In particular, 300 meters from fault No 1 with a throw of 197 meters, 65 small faults have been seen during tunneling and stoping. At the same time, the hydrogeological conditions of the stope are complex, the amount of gushing water reaches 1.46 cubic meters/minute, the floor is also uneven and water easily accumulates. This causes difficulty in mining. After joint studies by geological survey and design personnel and personnel of the stope, they first used prospecting tunnels to understand the patterns and characteristics of the small faults, then they drilled water outlets in the lower tunnels to drain the water and prevent water from accumulating in the coal cutting face and the tunnels. They exerted all efforts to improve the working conditions and finally mined over 400,000 additional tons of coal from the complex geological conditions of the coal seam and increased the recovery rate. Over the last several years, this mine has strengthened geological survey work and extracted 133,000 tons of leftover pieces of coal, 1,094,000 tons of coal from step coal columns, and has mined 1,267,000 tons of coal under especially complex geological and hydrogeological conditions, making a total of 2.5 million more tons of coal extracted.

Some mines conscientiously explored and understood the thickness of the coal seams, carried out rational mining, and recovered more coal for the nation. For example, the original plan of the Fengfeng Mining Bureau called for mining the 02710 coal column and the 0273 face of the Tonger Mine in two levels. After probing and understanding the thickness of the coal seam, the plan was changed to three level stoping, and 15,640 more tons of coal were recovered. Conversely, at some mines, the thickness of the coal seams of the faces was only 3 to 3.3 meters, but because the thickness of the coal seams was not probed and understood, only 2 to 2.2 meters were mined, losing 18,016 tons of coal. Also, for example, while stoping the upper sublayer face of the inclined sublayers in the Dahuangshan Mine of the Xuzhou Mining Bureau, the thickness of coal of the lower layer coal seam was probed after advancing every 10 meters to 15 meters, and in the stoping tunnels, the entire thickness of the coal seam was probed generally every 10 meters. This provided references for accurately determining the thickness of the sublayers and the positions of jump surfaces and points of contact during tunneling and the positions of advance supply tunnels and chutes. This basically prevented the loss of roof coal, floor coal and leftover pieces of coal, and increased the coal recovery rate.

There were also mines that understood in detail the boundaries of the faults, determined the reasonable dimensions of the coal columns, and increased the recovery rate of coal resources. For example, a large fault with a throw of 600 meters was discovered at the deep part of the Fenguangsan Pit of the Shulan Mining Bureau. Geological prospecting estimated on the basis of the discovery that the other wall of the fault was green gritstone, that the water filling properties of the fault would be good and the amount of water would be considerable. Therefore, in the design, a large coal column of the fault was included. After the mine began production, detailed surveys and studies were made again and the gritstone was determined to be pelitic cementation, and it was believed that the amount of water near the fault would not be too great. At the same time, two holes were drilled to probe for water and gushing or leakage did not occur. Then, a prospecting tunnel was dug for draining water and this proved that the amount of water was small. Therefore, the original design was revised and the coal column of the fault was reduced by 50 meters, so the recovery rate was increased.

Some mines with more complex hydrological conditions strengthened hydrogeological work, clearly understood the hydrological conditions and actively controlled water damage and increased the workable reserve. For example, the Xishan Mining Bureau compiles a diagram of water filling characteristics in mines each year. Based on arrangements of stoping and tunneling, it insisted on the principles of probing whenever in doubt and not tunneling without probing first. For several years, over 50,000 tons of water which had accumulated in old coal pits were probed and drained. This not only stopped incidents of water permeation, it also freed some coal seams threatened by water damage and added over 3.2 million tons of workable reserves. Also, for example, the amount of water gushing in the Qiupigou Mining Fields of the Nanpiao Mining Bureau was large. In 1962, the fields were flooded by water that suddenly gushed from the Ordovician limestone crevasse, and production ceased for two months. After this lesson, they strengthened surveying and prospecting the water of the Ordovician limestone crevasse and at the same time established special personnel to manage small local coal pits, learning the number of small pits, their positions, their mining area, and their accumulation of water. Through comprehensive analysis and study, the causes of water filling and their hydraulic connections in the mines were basically understood. Such studies provided geological data in many aspects for safe production at the mines and actual data on the amount of gushing water. Thus, over 7 million tons of workable reserves threatened by water from the Ordovician limestone crevasse at that mine were freed. Also, for example, the Fengfeng Mining Bureau strengthened hydrogeological work in mines, and actively controlled water in the Ordovician limestone bedding planes. Since 1977, it has drained a large amount of water from the second, third, and fourth mines, and has conducted experiments in extracting small pieces of soft coal. Up to the present, over 2.4 million tons of small pieces of soft coal have been mined, and the recovery rate of coal has increased.

At some older mines, the loss of coal had been very serious because of the backward, plundering methods of coal mining of the past. Many mining areas strengthened geological work in the mines, and after basically grasping the geological conditions of the old mining areas and the mining situation of the current year, they made further efforts to select appropriate sites for prospecting to check the thickness of residual coal, the scope of distribution and the geological structure, and the hydrogeological conditions and fragmentation conditions of the roofs and floors. Then, they mined the coal again to extract to the maximum extent the coal that was lost in the past. For example, during the 3 years from 1977 to 1979, the amount of residual coal extracted from the old mining areas by the Liaoyuan Mining Bureau constituted an average of about one-sixth the total annual production. Since 1970, the Benxi Mine of the Benxi Mining Bureau extracted a cumulative total of more than 8 million tons of residual coal. The recovery rate was increased and the life of the mine was prolonged 10 years.

## III. Some Views on Strengthening Geological Work in Mines and Increasing the Recovery Rate of Coal Resources

Because geological work in mines is weak, losses have increased and the recovery rate of resources has been lowered. Among the losses in extraction, there are also some losses of coal resources which seem to be losses due to extraction, but which are actually caused by the inability of geological work in the mines to catch up and to provide sufficient geological parameters related to the coal seams for mining. Therefore, strengthening geological work in the mines can not only reduce geological loss, it can also reduce a relatively large portion of losses during extraction, and so it is also an important aspect in improving the recovery rate of coal resources. Based on the experience of concerned bureaus and mines in this regard, the following exploratory views on strengthening geological work in mines and improving the recovery rate of coal resources have been proposed:

1. In recent years, the Ministry of Coal Industry has began to emphasize geological surveys of mines. Some bureaus and mines have already stored their agencies. Units that have not established or restored geological surveying agencies and reserve management agencies must quickly establish or restore them, and they must quickly solve the problems of insufficient technical personnel, clearly establish the supervisory authority of geological surveying and reserve management agencies over the recovery and the percentage of recovery of coal resources.

2. Geological work in mines must investigate and understand clearly the changing patterns of the thickness of coal seams. The thickness of coal seams is an important basis for determining the method of coal mining and the distribution of tunnels. For example, one mine surveyed the thickness of its coal seam and determined it to be 5 meters. Plans for bi-level mining called for extracting 2.3 meters to 2.5 meters of the roof layer and 2.4 meters to 2.6 meters of the floor layer. But because probing the thickness of the coal seam was not done in detail again during the course of mining, it was discovered after mining of the roof sublayer was completed that the thickness of the coal layer was only 4 meters, and at some sections, it was less than 4 meters. The bottom sublayer was only about 1 meter thick, so it had to be abandoned. This created a loss of a large thickness of coal. Also, for example, a stope of one mine reached a thin belt of a coal seam and the tunnels did not reach the boundary, thus a block of coal extending over 200 meters along the strike was abandoned, resulting in a loss of over 100,000 tons of coal.

Geological work in mines must investigate clearly the thickness of the coal seams and their variations, and draw diagrams showing these things to serve as a reference for mining plans.

3. Geological work in mines must clearly investigate the geological structure of the coal seams and related parameters. The geological structure of coal seams, especially the position of faults and the size of the throw are important bases for rationally zoning the mining area. For example, some mines found two faults with a throw larger than 30 meters during detailed prospecting, but, after mining began, many faults with a throw larger than 50 meters were actually discovered. Because the number of faults increased in the course of mining, there was a lack of accurate understanding of the parameters related to the faults. This not only increased the number of coal columns, the coal columns were also larger, and over 5 million tons of the reserves of the first horizon were lost, 30 times the loss estimated in the design. Also, for example, at some mines, many of the faults defined by detailed investigation were actually anticlinal tectonics, thus after tunneling, coal seams could not be found. This not only wasted construction, a massive amount of coal resources was also lost, and the recovery rate reached only 44 percent. Again, for example, one mine did not discover faults that cut coal

seams within the area of 13 square kilometers prospected during detailed investigation, but after mining, 12 faults with a throw of 10 meters, 93 faults with a throw of 3 to 10 meters, and 267 faults with a throw of about 2 meters were found within an area of 2 square kilometers in the immediate mining area alone. The coal seams were greatly destroyed, making the coal mining methods and the distribution of tunnels of the original design seem very irrational, and the industrial reserve was reduced by over 2 million tons. According to analysis of some mines, the reserve loss caused by medium and small faults generally constituted about 20 percent to 30 percent of the total reserve loss. In particular, the positions and parameters of faults in mining regions where faces are mined by comprehensive mechanized methods must be more accurately determined, otherwise, a greater loss of coal resources will be created.

Geological work in mines must be based on prospecting reports, and it should use traditional geological methods of supplementary drilling, tunnel prospecting, actual measurements, investigation, realistic descriptions, coal-rock ratios rock, and comprehensive analyses to make a more accurate judgment of the positions of medium and small faults and their related parameters to draw diagrams to serve as references for designing the mining area and the mining methods, thus reducing the loss of coal resources as much as possible and increasing the recovery rate. At the same time, it should actively study and utilize new techniques of seismology, such as the study and utilization of ground surface high resolution earthquakes, earthquakes in holes, earthquakes along the same stratum (channel wave earthquakes) so that medium and small faults and geological tectonics of coal mines can be more effectively, rapidly, and clearly understood.

4. Geological work in mines must investigate clearly the conditions of deposits of coal seams near the main coal seam being mined to determine a rational mining order. This is because when prospecting coal fields of multiple coal seams frequently only the main coal seam with a superior reserve is taken as the target for prospecting. The magnitude of the reserve is relatively high and the magnitude of some of the insufficiently stable coal seams nearby is lower. If the nearby coal seam in the upper part of the main seam to be mined is not clearly investigated and mined in time before mining of the main seam begins, it will be destroyed and will have to be abandoned. For example, one of the mines had a small coal seam 20 meters above the main coal seam. The small coal seam was 0.8 to 1.2 meters thick and had a relatively high ash content and poor stability. The small coal seam was not clearly investigated during prospecting and the magnitude of the reserve was low. Later, geological work in the mine did not catch up, so after the coal was mined, the small coal seam above was destroyed, losing more than 1,500,000 tons of coal resources.

5. Geological work in mines must clearly investigate hydrological conditions in the mines, the condition of gas in the pits, spontaneous ignition in coal seams and the roof and floor of coal seams. Our nation has many coal seams that are threatened by alluvial strata and water between limestone bedding planes, and thus the amount of coal that cannot be worked is large. In some places, the amount of unworkable coal in coal seams partially threatened by water between limestone bedding planes constitutes 48 percent of the present reserves. Some coal mines did not clearly understand the structure of alluvial strata and limestone, their water-rich characteristics and the basic patterns of movement of groundwater after mining, and overly large coal columns for water prevention were kept. Thus, large amounts of coal resources were lost and the recovery rate dropped.

In addition, mine shaft gas, spontaneous ignition in coal seams, and the lithological properties of the slate roofs and floors of coal seams all have a definite effect upon the method of mining coal, the distribution of tunnels, and the selection of columnless extraction methods. Therefore, they also directly or indirectly affect the recovery rate of coal resources. Geological work in mines must also investigate these clearly.

6. Geological work in mines must gradually establish a more perfect reserve management system. The Tangjiazhuang Mine in Kailuan established 10 types of accounts and five types of diagrams to strengthen reserve management. Some coal mines have also established systems of review and inspection, methods of calculating recovery rates, monitoring systems, and methods for writeoffs of reserves with the participation of geological surveying and reserve management personnel to prevent various unreasonable losses of coal resources and to ensure that the recovery rate of coal resources can be increased.

7. The relationship between geological work in mines and mining work must be correctly handled. Increasing the recovery rate of coal resources is the common task of geological work and mining work. Geological work in mines uses various geological methods to investigate clearly the geological structure of coal seams and to serve more rational mining so as to extract additional coal resources as much as possible. But in mining work, many new geological phenomena can be discovered, and they make it possible for geological studies of mines to make more accurate judgments about the geological structure of the coal seams and make the mining plans more reasonable. The Tangjiazhuang Mine at Kailuan correctly handled the relationship between geological and mining work, and even though the geological structure of the coal seams was complex, less coal was lost, more coal resources were extracted, and the recovery rate was increased.

8. The technical and economic results of geological work in mines must be comprehensively evaluated. Geological work in mines must probe all doubts and strive to clarify the situation. In particular, geological work must be strengthened to study sections of the coal seams having complex geological structures, to clarify the resources, to rationally develop coal resources, and to improve the recovery rate of the resources so that better technical and economic results can be realized. This requires the addition of some prospecting projects that will increase the cost per ton of coal, and in individual cases, this will even create losses. But, technologically speaking, this is necessary. In the macroeconomic viewpoint, we must also see that coal can create value and profits when used as fuel and raw material by other departments. Therefore, its technical and economic results must be comprehensively evaluated. This portion of loss should be subsidized. In particular, since coal resources are nonrenewable energy resources, to a socialist nation, increasing the recovery rate of coal resources should be encouraged by economic policy. Which part of the geological structure of coal seams should be investigated clearly during the geological prospecting stage and which part should be left for investigation during geological work in mines should also be subjected to technical and economic analysis so as to realize the best technical and economic results.

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# IMPROVED TECHNOLOGY SPELLS HIGHER OUTPUT

## Large-Scale Modern Mine Is Showcase Example

Taiyuan SHANXI RIBAO in Chinese 16 Oct 81 p 1

[Article: "Gujiao's Xiqu Mine Built With Speed and Quality"]

[Text] Built with speed and quality, Gujiao's Xiqu Mine is a modernized mine designed and constructed by our country. From the time the construction began in August 1979 to now, some 18,500 meters of large sectional headings and slopes have been tunnelled. Three underground coal storage areas are currently being constructed with redoubled efforts. An underground lot for vehicles has been completed. The Tunnelling footage of the chief projects throughout the entire mine is now 85 percent of the projected footage. The engineering quality is completely up to the standard requirements set by the state, and 66 percent of the work is rated as high quality.

The Xiqu Mine is a large-scale modernized mine with an annual output capacity of 3 million tons. It is listed as one of the major construction projects in the state's plan to consolidate the national economy. To step up the construction of the mine, the officers and men of an engineering regiment assigned to the construction project swung into the role of a PLA shock brigade and put their shoulders to the plough in arduous struggle, thus exceeding the state plan year after year. Last year alone, the regiment accomplished 8,055 meters of tunnelling footage and the engineering quality was 100 percent up to standard requirements. Six out of seven tunnelling companies who have been on the project the whole year now rank among the national level coal mine excavating teams. This year, the engineering regiment encountered such difficulties as tunnel roof cave-ins serious inundation, etc. The officers and men pitted against the difficulties with bravery, marching onward boldly and continuously accelerating the tunnelling speed.

To hasten the mine construction, the leading cadres of the regiment often go down to grass-roots units to investigate, study and solve problems. Last year, each of the nine standing members of the regiment's Communist Party Committee spent an average of 87 days to gain firsthand experience in selected companies; from January through August this year, each of them made an average of 118 trips down to the mines.

9119
CSO: 4006/112

## Concentrated Level Mining Method

Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese No 12, Dec 81 pp 11-12

[Article by Zhu Qilin [2612 0796 2651], Datong Mining Office: "Rational Level Concentration in the Datong Mining Area"]

[Text] At present, rational concentration of mining levels is one important aspect of rational mine exploitation. The mines under this office are working nearly horizontal, closely spaced groups of coal seams, and the arrangement of production levels has developed from single-seam production levels, through multiple production levels working several seams simultaneously, to concentrated production levels working several seams simultaneously.

## 1. Problems

Incorrect layout of levels or the use of too many levels has a rather large negative effect on output. For example, when the Xinzhouyao mine went into operation in 1957, its total reserves were more than 200 million tons, with 11 workable seams, but because the first level was located too high, it could be used to work only two thin seams about a meter thick (numbers 3 and $3^{-1}$). Partly because the workable perimeter had decreased, 3 years after production began the remaining workable period for the first level was only 5 years. There was no recourse but to open the +954 auxiliary level, which went into production in 1963, so that there was simultaneous production on the main and auxiliary levels, but it was still impossible to achieve the planned annual capacity of 900,000 tons, in addition to which it was difficult to switch operation from one level to the other. As a result, in 1969 a second level, +865, was opened up, and only with the start of production on this level in 1979 was the negative state of affairs set right.

Thus two levels were opened in this mine in only 22 years, and capital construction and production were doubled up for 12 years, making it impossible to achieve planned capacity for that 12-year period; as a result, not only was the investment cost large and output low, but there was a loss of 8.94 million yuan. A comparison with the Meiyukou Mine (Table 1) points up the defects of unsuitable disposition of levels.

Table 1 Comparison of Various Indicators from the Yizhouyao and Meiyukou Mines

| 1) 矿 别 | 5) 投产时间 | 设计能力 6) （万吨/年） | 从1958～1969年平均产量 7)（万吨/年） | 到1968年末的基建投资费 8)（万元） | 1969年前平均 9) 采掘人员比例 | 1969年前原煤生产人员效率 10)（吨/人·年） | 1969年前平均成本 11)（元/吨） |
|---|---|---|---|---|---|---|---|
| 2) 忻州窑 | 1957.10 | 90 | 78.59 | 2815.51 | 1:0.72 | 250.6 | 14.16 |
| 3) 煤峪口 | 1957.7 | 90 | 116.08 | 2057.2 | 1:0.63 | 319.47 | 10.57 |
| 4) 对比(±) | | | +37.49 | −758.31 | −0.09 | +68.87 | −3.59 |

Key:
1. Mine
2. Yizhouyao
3. Meiyukou
4. Comparison ±
5. Date entered production
6. Designed capacity (10,000 tons/year)
7. Average output from 1958-1969 (10,000 tons/year)
8. Capital construction investment costs as of end of 1968 (10,000 yuan)
9. Average extraction-personnel ratio prior to 1968
10. Raw coal production personnel efficiency prior to 1969 (tons/person·year)
11. Average cost prior to 1969 (yuan/ton)

The Baidong mine is a case similar to the Xinzhouyao mine. Summarizing the lessons of incorrect disposition of levels and simultaneous operation of more than one level as described above, when choosing the location of levels attention must be given to the factors described below.

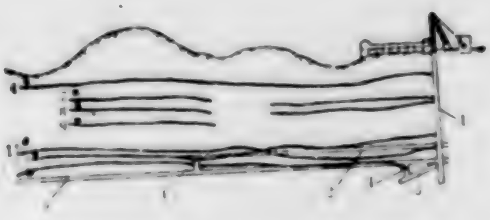
a. A production level must have sufficient reliable reserves and must have stable medium-thick and thick strata as its main seams. The working life of a level in a major mine should be at least 30 years.

b. When the spacing between the highest and lowest seams of a nearly horizontal, closely spaced group of seams is about 100 meters, every effort should be made to work the seams from a single level.

c. When the roof rock is hard, inward pressure over a large area and there exist specific conditions for spontaneous ignition of the seams, the level drifts should be laid out in the rock below the lowest of the group of seams.

2. Concentration of Levels

In the past 7 years, as mine technology has been improved, the combination of a number of production levels, improvement of the disposition of production levels and location of drifts in the floor rock have decreased the total number of levels being worked under this office to 16; output has doubled during these 7 years, the panel area and the relative number of miners have not increased, and there has been no drop in coal quantities or the working life of the levels, so that the advantages of reasonable concentration of mining levels have been thoroughly realized. For example, the planned annual productive capacity of the Tongjialiang Mine was 1.2 million tons and there were 10 workable seams spaced over a total of 104 meters, with a geological reserve of 300 million tons. The main tunnel for the original +1035 and +1013 production levels had a 600-mm track gage and used 1-ton mine cars. In 1975 it was decided to eliminate level +1035, and a total of 650 meters of improvement work was done at the bottom of the mine, the 1-ton fixed mine cars were replaced by 3-ton bottom-unloading mine cars, and the 10-ton electric cable locomotives were replaced by 12-ton models. Without decreasing the annual growth of output, the level concentration project was completed within 3 years, yielding good results (see figure, Table 2).



Cross-sectional diagram of level concentration of Tongjialiang mine

Key:

1. Vertical shaft
2. Level 1035
3. Level 1013
4. Coal accumulation areas
5. Inclined shaft with conveyor

Table 2. Comparison of multilevel and concentrated level operation

| 1) 项别 | 开拓工程 2) 水平运输大巷(米) | 3) 环节能力(万吨/年) |  |  |  | 8) 占用设备数量 |  |  | 井底车场人 13) 员 (人/班) |
|---|---|---|---|---|---|---|---|---|---|
|  |  | 大巷运输能 4) 力 | 井底车场 5) 通过能力 | 翻笼卸载 6) 能力 | 井底煤仓容量 7) (吨) | 架线式电机车 9) (台) | 10) 矿车(辆) 三吨底卸 11) | 一吨矿车 12) |  |
| 14) 多水平 | 20000 | 231 | 347 | 326 | 414 | 16 | — | 1600 | 13 |
| 15) 集中水平 | 13000 | 367 | 367 | 1499 | 1770 | 13 | 400 | 800 | 2 |
| 16) 比较(±) | −7000 | +136 | +20 | +1173 | +1256 | −3 | +400 | −800 | −11 |

Key:
1. Item
2. Horizontal transport drift length (meters)
3. Capacity of mine areas (10,000 tons/year)
4. Main drift transport capacity
5. Shaft mine car station throughput capacity
6. Tip cage loading and unloading capacity
7. Capacity of coal accumulation area at bottom of mine (tons)
8. Equipment required
9. Electric cable locomotives
10. Mine cars
11. Three-ton bottom-unloading cars
12. One-ton cars
13. Personnel in shaft mine car station (persons per shift)
14. Multilevel
15. Concentrated level
16. Change

shaft station
shaft bottom
shaft pocket

As the figure and table indicate, level concentration at the Tongjialiang mine was not complex, requiring only 650 meters of shaft and drift construction, with a future saving of 7,000 meters of main drift, in addition to which the loss of 4 million tons of main drift supports was recoverable; the main drift transport capacity was increased by 58.87 percent, and the mine's annual output was increased from 1.512 million tons to about 2.30 million tons.

In the past 7 years, this office has carried out level concentration and technical renovation of six mines and has met with some success, achieving a doubling of output. This work was carried on simultaneously with technical reequipping of the mines and concentration and reorganization of working areas, otherwise it would not have been possible to increase integrated production capacity. The following measures must be taken when implementing concentrated level production.

1. While concentrating production levels, attention must be devoted to improving transport conditions along the main drift. In 1974 total drift transport capacity under this office was 23.35 million tons per year, while in 1981 the figure had increased to 38.52 million tons per year. The new horizontal main drift at the Xinzhouyao mine, for example, had two 1-meter-wide steel cable belt conveyors for transport, providing continuous belt transport from the working face to the main drift and increasing transport capacity for each level by 960,000 tons per year.

2. The key to concentrated level production is rationality: when dealing with nearly horizontal, closely spaced groups of seams it is not enough simply to operate a single level. In the Yungang mine, for example, the area accessible from the shaft is 80 square kilometers, 11 seams can be worked, and the geological reserve is 900 million tons. With a calculated capacity of 2.70 million tons per year, and two-level extraction is planned; because five seams are being worked on the current first level, the current reserve of 580 million tons can be worked for 100 years. Even though the problem of switching levels would be avoided, to stress extraction from only one level clearly would be economically ineffective.

3. The main drifts for level concentration should be located as dictated by the local conditions. When the perimeter is not far from the drift, and the three coal capacity parameters are sufficient, a changeover can be made to the use of conveyor belts which follow extraction of the coal seam, concentrating the coal in the drifts and in pockets, so as to institute large scale retreating coal extraction.

## Elimination of Multi-Level Mining Urged

Beijing MEITAN KEQUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese No 12, Dec 81 p 13

[Article by Li Sijun [2621 0843 6511], Xiezhuang Coal Mine, Xinwen Mining Office: "Two Methods of Implementing Rational Level Concentration"]

[Text] The four coal mines under our office, namely the Suncun, Zhangzhuang, Liangzhuang and Xiezhuang mines, have a total run length of 19.5 kilometers. Because of the small scale of mine construction in the 1950's, the run length was essentially adequate. But over the course of many years the rate of extraction has been stepped up, so that currently the mines' productive capacities are 0.95 million, 1.20 million, 1.10 million and 1.40 million tons per year respectively, 55 percent higher than initial planned capacities, with an average extraction capability of 225,000 tons per kilometer of run. In the Suncun, Zhangzhuang and Liangzhuang mines, the average length of run is only 3.1 kilometers, less than half of the design extent. This decreases the working life of the mine levels and makes it difficult to enlarge the levels. It will be necessary to enlarge them again after 10 years in the Suncun and Liangzhuang Mines and after 14 years in the Zhangzhuang Mine. At the same time, because of the trouble involved in extending the levels, it will become difficult to continue production; the Xiezhuang, Liangzhuang and Suncun mines all continually operate 2 or 3 downward stoping areas, so that effort is dispersed by mining simultaneously from many levels. Recently, in order to institute production with reasonable level concentration, we have focused on the types of work described below.

1. Increasing the extraction intensity of old levels and realizing single-level production as rapidly as possible.

The main reasons for multilevel production in a mine are the following.

a. When the vertical distance of a mine section is only about 100 meters and it is necessary to have 2 to 3 levels operating simultaneously to meet production requirements. For example, production on two levels, new and old, after extension work in the Xiezhuang mine involved the addition of 120 transport and electrical machinery workers, and because of a difference in the track gages, six sets of tipping equipment had to be added at the pit bottom and the pit head.

b. When the mine run length is short and the extraction intensity is great. For example, the Suncun mine has only slightly over 2 km of run and only three extraction areas; each level has only 10-12 years of working life, in addition to which the relation between extraction of the retreating and advancing sections increases complexity, so that 30 to 50 percent of the time both levels are in production simultaneously.

c. Multilevel production resulting from inefficient extraction. At the Xiezhuang mine, seams 2, 4 and 11 of level 1 were completely worked out by 1980, but because seams 6, 13 and 15 had complex hydrogeological conditions, a long time was required to work them, so that extraction of levels 1 and 2 will overlap for 10 to 15 years. Again, in the last few years primarily the retreating sections have been extracted at the Liangzhuang mine; extraction of the retreating sections and the coal in seam 6 has lagged, with the result that levels 2 and 3 will be producing simultaneously for as long as 7 years.

The circumstances described above can be dealt with not only by rational organization of extraction and by increased extraction intensity, but also by means of certain improvement projects in which the remaining reserve of the upper level is transferred to extraction from the lower level. For example, in the Xiezhuang mine extraction of seams 13 and 15 was transferred to the lower level, making it possible to eliminate multilevel production 10 years early, so that the same track gage could be in use at the pit bottom and pit head, making concentrated production possible.

2. Increasing the sectional height and reserves of new levels so that a single level meets all of the mine's productive capabilities.

The third level in the Suncun mine has a vertical height of 135 meters, and its operating life is only 14 years. If the height of the fourth level were increased to 200 meters, its reserves would be increased by 50 percent, which would be favorable to concentrated level production. In order to solve the problem of difficulties in continuing the levels, the office has already extended the height of 7 mine levels to 200-250 meters, as a result of which since 1976 productive capacity has been increased an average of 10.7 percent a year.

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CSO: 4006/227

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# Shanxi Machinery Plant Helps Create Energy Base

Taiyuan SHANXI RIBAO in Chinese 22 Nov 81 pp 2, 3

[Article by Shanxi Machinery Plant party secretary Zhang Youxian [1728 0645 6343]: "Striving for a Fast Pace Supporting Construction of the Energy Base"; advertisement of plant's products appended]

[Text] During the readjustment of the national economy, will the machine-building industry be able to develop at a reasonable good pace? Two years' experience at our plant demonstrates that although the road is hard, provided that the guiding ideology is correctly reoriented, initiative is taken in surveying needs, an effort is made to readjust product breakdown, rational prices are maintained and good technical service is provided, it will still be possible to achieve a fair pace of development. Our plant is striving for speed in its support of construction of the energy base.

This province is one of the country's key coal bases. Its seven large centrally-run coal mines and more than 2,000 medium and small-size mines need to purchase about 300 million yuan worth of machinery and equipment a year, of which our province produces less than 10 percent. Our plant is an old one, producing primarily hoisting equipment and mine machinery. It has the capability, the equipment and the technology to produce coal mining equipment, and in the readjustment period the problem is not "undernourishment," but instead is that of going ahead and "eating the choice cut of meat." The leadership of our party committee overcame the negative attitude of the "one equality, two contingencies and three dependences" and resolved to "eat the choice cut of meat" by focusing production on support of the coal mining industry. Once we had set our course, we stepped out boldly, making survey visits to the users. We paid visits to the Xishan mining office and to users in Yangquan, Datong, Changzhi and Hou Counties, sold our products and gained more than a million yuan worth of orders; once these markets were opened, we immediately made bold reforms in our management system,. We set up a leadership group for service to coal production, headed by the plant director, in addition to which the No 1 machining shop, which had the most employees, the most complete facilities and the greatest production capacity, was made into a coal mining machinery construction and repair shop, and the military engineering shop was converted to a primary focus on the production of coal mining machinery, thereby increasing the capacity for serving the coal production, so that now we have increased our output of products which serve coal production to eleven varieties and sixteen models, accounting for 50.08 percent of the plant's total output.

In order to maintain a certain pace of development and to function successfully as the "equipper" of coal production, product quality must be up to standard and win the trust of the users. In order to improve product quality, we started comprehensive quality management activities, increased the rigor of all process sequences and made all job responsibilities more stringent, constantly employed a three-way combination of self-inspection, mutual inspection and use of inspectors, and drafted a set of quality upgrading measures, with the result that the acceptance rate for the main coal mining machinery produced by our plant increased to about 96 percent.

In order to maintain a certain pace of development, products must be reasonably priced. Accordingly, the prices for coal mining machinery produced by our plant are never higher than comparable products in the industry. We have also begun to make our calculations in terms of the whole picture and to focus on small profit and large volume. Some products are urgently needed by the coal mines; even if we lose money on them at the moment, we will still produce them.

To maintain a certain pace of development, it is particularly important to improve our service attitude. In the past we were complacent about our importance, our technical service was sometimes good and sometimes bad, and our attitude was sometimes distant and sometimes warm. This lost us some customers, and in the last two years we have come to understand better the importance of this matter: since we are a service plant, we should be giving wholehearted service to the coal industry. Accordingly, a service group for supply of parts and assemblies has been set up at the plant, a technical service team has been organized to visit the coal mines at regular intervals and overhaul the equipment, and if defects are found in products of our sister plants, we will repair them if the mine asks us to. In this way the commercial relations between the mines and the plant have developed into brotherly relations of mutual support, unity and cooperation, and a common struggle for the four modernizations.

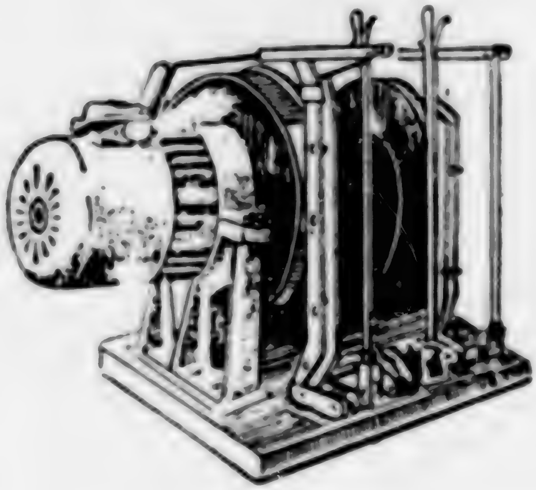
To maintain a certain pace of development, it is also necessary to stress product modernization. Our plant is consciously implementing the party's policy on intellectuals and it has mobilized the enthusiasm of our engineering and technical personnel to go all out in designing and producing whatever the coal mines need. For example, the 25KM spotting hoist, the 0.8 winch and other new products which are currently selling well inside and outside the province were put into trial production on a crash basis at the user's request. At the same time, for our traditional products such as forklifts, not only have we brought out five new design variants, but recently we also designed and produced eighteen specialized accessories to increased the versatility of the machines; these have been highly praised by the users. Thus we have found some ways of maintaining our pace of development, and this year our total output value will be 10 percent higher than the target assigned by the higher levels. Currently the plant's party committee is taking steps and writing articles on the "superiority, low price, fast delivery and modern design" of the products so as to move up another level next year.

[Advertisement]

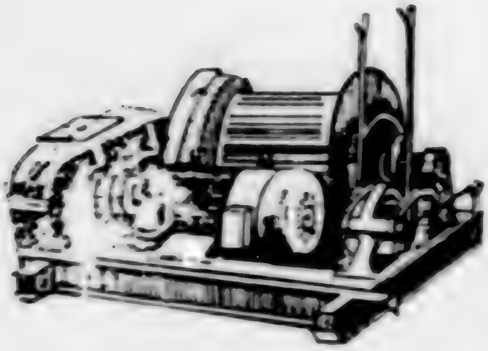
The Shanxi Machinery Plant--Wholeheartedly Serving Coal Production

The quality of our products is reliable, their prices are reasonable, a full selection is available, and we can install, adjust and test equipment for the user, train operating personnel, supply spare parts and assemblies, and provide regular in-plant technical servicing.

The Shanxi Machinery Plant can produce standard and nonstandard equipment and assemblies and machine castings and forgings.

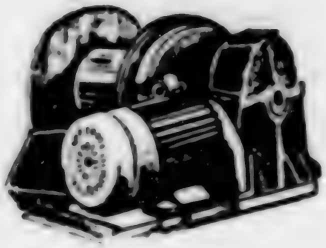


The JD-25 spotting hoist. Cable capacity 400 meters; drawing force 1,800 kilograms; cable speeds 1.39 m/sec (high) and 0.77 m/sec (low).

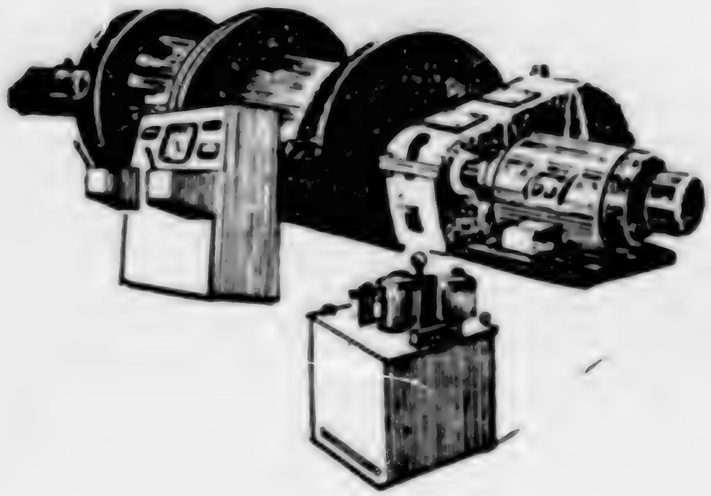


[Winches:] Main parameters:

| Model | 30 kW | 22 kW | 17 kW |
|---|---|---|---|
| Static drawing force (kg) | 2500 | 1500 | 1200 |
| Cable capacity (m) | 400 | 480 | 480 |
| Cable speed (m/sec) | 66 | 60 | 60 |

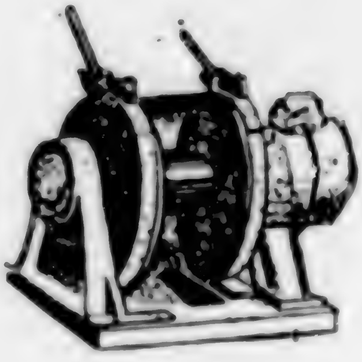


$JH_2$-14 prop winch



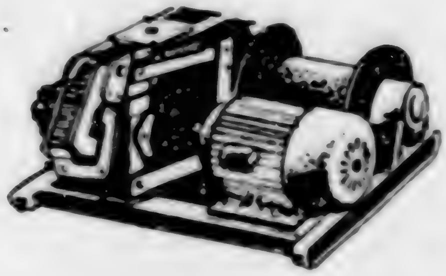
2JTP and 2JTK series mine hoist winches

2JTP and 2JTK model 1.2 double-drum winch
2JTP and 2JTK model 1.6 double-drum winch
2JK-2 mineshaft hoist
JTP and JTK model 1.2 single-drum winch
JTP and JTK model 1.6 single-drum winch
2JTK$\frac{1600}{1224}$ model 1.6 double-drum winch

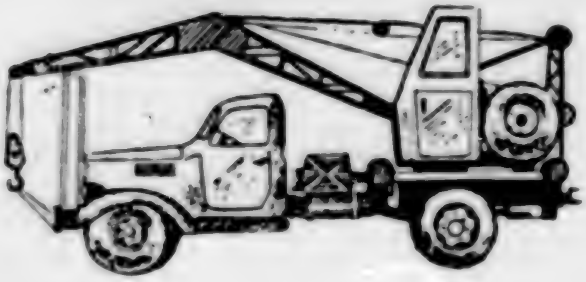


JD-11.4 spotting hoist: drawing force, 100 kg; cable speed 62 m/sec, cable capacity 400 m.

## Traditional Products



JJKD-1 1-ton single-drum electrically controlled hoist



Q51 vehicle-mounted crane:

reduction gears (Pm series 250-1000)
JJK hoist

CPQ1 loading-unloading forklift. Main uses: The CPQ1 forklift is an internal combustion type straight-fork balanced-load 1-ton loader-unloader. It is suitable for warehouses, docks, depots, harbors, construction sites, mining enterprises and the like, and is usable for loading-unloading, handling and stacking. Use of various accessories can increase its range of applications.

Plant address: Xiaodongmen, Taiyuan City.

8480
CSO: 4006/170

## Defense Industry Supports Coal Production

Taiyuan SHANXI RIBAO in Chinese 22 Nov 81 p 2

[Article: "Bring the Advantages of the Military Industry Into Play in the Service of Coal Production"]

[Text] The state-run Xinhua Chemical Engineering Plant has brought its productive capabilities and the advantages of its technological contingent into play, providing active service to coal production. The conveyor belts, rubberized mixed glass fabric air duct tubing, and miner's personal emergency equipment which it produces, which are of good quality and are cheap to produce, have been welcomed by the users and are selling well both inside and outside the province.

The plant's conveyor belts are resistant to acids, alkalis and high temperatures, the product acceptance rate is as high as 99.99 percent, and the percentage of units rated in the top grade is as high as 98.4 percent. Their service life may be as long as 14,000 hours, or even longer. Last year they were ranked second nationally among products of the type and were awarded the designation of "superior quality product" by the Ministry of Chemical Engineering and the province. The current annual output of 2 million square meters is selling rapidly in 26 provinces and cities. The rubberized fiberglass fabric mine air duct tubing has the advantages of light weight and resistance to abrasion and tearing, in addition to which it is equipped with strong iron collars. The quality meets state standards, and the annual output is 2,000 kilometers. The miner's personal safety equipment adopts the good points of similar U.S. and Japanese equipment and provides protection against poisonous gases and smoke. It has undergone two simulation tests in Shanxi coal mines, in which it was able to withstand high gas concentration for up to 50 minutes. The relevant departments have ascertained that its quality is in accordance with standards, and there is capacity for the production of 200,000 sets annually.

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CSO: 4006/170

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## Liupanshui Coal Base

Beijing DILI ZHISHI [GEOGRAPHICAL KNOWLEDGE] in Chinese No 9, Sep 81 pp 6-7

[Article by Ma Qingyi [7456 3237 5940]: "First Visit to Liupanshui--Occasional Notes on a Survey Trip to Industrial and Mining Cities in Three Southwest China Provinces"]

[Excerpts] Last winter and this spring, our group of ten-odd persons who had undertaken a scientific research project on behalf of a government department, left Beijing on a survey tour of three Southwest China provinces--Yunnan, Guizhou and Sichuan--to find out about the long-range plans of their industrial/mining cities and districts. Guizhou was the first stop on our excursion.

The first thing that we learned in Guizhou was about the changes in Liupanshui. Known for its complex topographical relief, high mountains and freezing climate, the place used to be inaccessible and economically backward. Since the mid 1950's when development operations began in the Liupanshui Mining District, it has become one of China's giant coal bases, with such industries as steel, electric power, building materials, etc. Originally, it was merely a handful of small towns, and the population was less than 80,000. Today, it is a new city populated by more than 300,000 people.

## Climbing to the "Rooftop" of the Guizhou Plateau

Topographically, Guizhou is a plateau-mountain area. The western portion is the highest part, the central portion is slightly lower and declines towards the north, east and south. In the western part of Guizhou, the altitude is 1,500-2,800 meters above sea level, and is known as the "roof" of Guizhou Plateau. Sitting on top of this "roof" is Liupanshui City.

We set off from Guiyang by train and sped westwards along the Guiyang-Kunming Railway. On the way, we saw mountain ridges and valleys rising and falling; the limestone mountains were high and precipitous, and between them there were some small intermontane basins and wide valleys (known as flatlands). Numerous tracts of farmland and villages were distributed over the flatlands. As the train raced onwards, the terrain gradually changed, and by the time we entered the city limits of Liupanshui and arrived at Liuzhi, the intermontane flatlands became increasingly scarce and replaced by mountains which grew increasingly populous. Sometimes our train had to climb difficult slopes, sometimes it passed through tunnels, and it traversed the Guizhou's Western Plateau.

We were told by geologists that approximately 70 million years ago, the Yunnan-Guizhou Plateau was a vast expanse of sea which upwarped during the "Yanshan Movement." The rocks there were primarily limestones with bands of basalt and arenaceous shale in between. Known as the "Roof Beam" by the local inhabitants, the plateau is characterized by gentle slopes on top and precipitous edges. When our train entered the seat of Liupanshui City--Shuicheng, the terrain became open and wide. Located northwest of and not far from Shuicheng is Jiucaiping, a basin 2,903 meters above sea level and is the highest peak on the "roof."

## The Largest Coal Base in South China

What interested us the most during our tour of Liupanshui City was its coal resources. Guizhou is endowed with very rich resources of coal, the proven deposits are only second to Shanxi and Nei Monggol, ranking third among all the provinces and districts throughout the whole country. Guizhou's coal reserves are chiefly formed in Liupanshui, which accounts for one third of the entire province's coal deposits. On its outskirts are the Zhina Coal Field and Xingyi Coalfield, which form a vast expanse of coal reserves in the western part of Guizhou. Liupanshui's coal reserves are mainly divided into three major portions: Liuzhi Coal Field, Shuicheng Coal Field and Panxian Coal Field. Liupanshui's coal reserves are not only plentiful, but also buried deep under the surface and easy to mine as well. In the course of our survey, occasionally we also came upon outcrops of coal seams in deep river valleys. The mining pits are distributed along the river valley and are mostly slopes or galleries. There is a fairly good assortment of coal varieties, including gas coal, fat coal, coking coal and lean coal. It is a major coking coal base of south China.

The development of the Liupanshui Coal Field began in the early 1970's. When the Central Committee of the Communist Party announced its decision to build the Liupanshui Mining District, many veteran miners and workers came from various parts of the country and pitched camps in this high and cold mountain region to participate in the development of the coal field. In 1964 alone, some 40,000 coal base construction workers were transferred there from many old or new mining districts in northeast China, north China and south China. Through years of hard struggle, the mining pits and plants finally went into operation in the early 1970's. Now, the entire mining district has completed 22 pairs of pits; the total projected capacity is 10 million tons; the actual output is over 6 million tons, and there are altogether more than 80,000 staff and workers working in the coal mine which has become a large coal base in China. The development of the Liupanshui Mining District is of great importance to solving the fuel shortage problem in south China. Approximately half of the current coal output is shipped to Yunnan, Guangxi, Guangdong, etc., and has greatly promoted the economic growth of these provinces and regions.

## Taking the Path to Comprehensive Development of Industry

According to a comrade in the Urban Construction Department, a fair amount of attention has been given to building the industry in a comprehensive way ever since the early stages of development in the mining district, and a great deal of effort has been made to avoid such problems as underemployment among women and inadequate use of resources, which some mining districts have incurred as the result of focusing on mining alone. The industrial development in this city falls into two aspects: one, developing industries that are closely linked to the local resources; two, developing industries that can serve the needs of the city's inhabitants. During our tour, we visited a steel plant and a power plant. The Shuicheng Iron and Steel Mill is situated in a small basin north of Chengguan Zhen, Shuicheng, and is located not far from the Guiyang-Kunming Railway as well as a water source. The plant was built in 1966. Completed in 1969, the pig iron production system went into full operation and began putting out iron. Coking coal is obtained from nearby sources; iron ores are partly supplied by the city's own Guanyin Mountain Iron Mine, and partly by various mining points inside and outside the province. In 1979, the pig iron output was 400,000 tons, which not only provided the needs of both the Guiyang Steel Mill and Shanghai Steel Plant, but also a small amount of exportation to other countries. At present, the city only has iron smelting which yields relatively poor economic results. If capital funds permit, an iron and steel integrated complex should be built as early as possible. Besides iron and steel mills, the Shuicheng Power Plant has also been constructed. Completed in 1974, the power plant has two 50,000 kw generating units in operational mode. There are pit mouth power stations in the mining district, which is a rational layout especially for such mining districts as Liupanshui which lacks sufficient means for shipping out coal. If water sources permit, efforts should be made to build as many power stations as possible so as to provide energy in the form of electricity. In the past, the city used to be relatively short of building materials; it used to procure bricks from other provinces to make up a portion of its annual needs. As the development got underway, the mining district built a new large-scale cement plant that could make use of blast furnace slag from the nearby Suicheng Iron and Steel Mill, producing 500,000 tons of cement each year, which not only provides the needs of its own city, but also Guiyang City as well.

## A Special Kind of City

In Liupanshui City, you will discover that the city does not have large tracts of tall buildings or criss-cross roads, and there are no shuttling buses or noisy crowds. This is because the entire city's population of 300,000 is scattered in fifty-odd residential points over an area of 10,000 square km, and, on the average, each residential point has only 6,000 inhabitants. But the residential points are not evenly spread out. Their distribution pattern basically conforms to the coal field distribution, thus forming three major areas that are relatively concentrated and centered around Liuzhi, Pan Xian and Shuicheng. In fact, Liupanshui City got its name by putting together the first character from each of the preceding three town names.

Among the various cities and towns in the Liuzhi District, the largest is Liuzhi Zhen. With a population of 50,000, it is the seat of the Liuzhi Special District Government, and is situated in a mountain valley. On its southern side are groups of mountains which form the watershed of Beipan Jiang (part of the Zhu Jiang System) and Sancha He (part of the Chang Jiang System). In the north lies the Sancha He Valley which is quite vast. Quite a few coal mines are distributed in the vicinity of Liuzhi Zhen, such as Bingshui Pit, Liuzhi, Dizong and Sijiaotian, Datian, etc. Moreover, large-scale coal mining equipment repair shops and food industry have also been developed to serve the coal mines. During the early period of growth in the mining district, Liuzhi Zhen was initially chosen as the site for setting up the governing body of the mining area because of its fairly good communication conditions and urban foundation. It was once a flourishing town with a brand new outlook. But due to its relatively distant location from the major mining areas, the governing body of the mining district moved to Shuicheng after the latter was linked to the Guiyang-Kunming Railway in 1966. Moreover, as its coal mining conditions are not so favorable as Pan Xian or Shuicheng Prefectures, it has developed comparatively slowly. There are relatively few industrial/mining cities or towns on the outskirts of Liuzhi Zhen; on its eastern flank lies Mugang Zhen with a population of 8,000; southwest of Liuzhi Zhen is Langdai Zhen, population 5,000; in the north, there are industrial cities and towns, such as Yanjiao Zhen whose population is less than 4,000. These cities and towns are 20-30 km from Liuzhi Zhen. They are linked together by highways, and communication is convenient.

Among the various cities and towns in the Shuicheng District, Shuicheng Zhen is the largest. Its population is 40,000. Located at the base of the Shuicheng Basin through which the Xiangshui He flows, the town was frequently hit by flood disasters in the past. After the liberation, water reservoirs were built on the upper reaches of the river, thus eliminating flood calamities. Due to the fertile farmland on the outskirts which made it impossible to further develop the cities and towns, a new city--Zhongshan Zhen--was built on Gaogangdi, located 6 km west of the area. Zhongshan Zhen now has a population of nearly 30,000.

Besides numerous coal mines, the key enterprise iron and steel mills, power plants and cement plants are also distributed around the periphery of Shuicheng-Zhongshan Zhen. In the east lies Laoyingshan Zhen with population of 18,000. In the north are Dahe Zhen, population 7,000; Wangjiaozhai Zhen, population 1,500. In the northeast, Dawan Zhen, population 8,000. Most of them are located 10-20 km from the center of the city; the furthest is over 40 km (Dawan Zhen), but communication with Zhongshan Zhen is still quite convenient.

In the last leg of the Liupanshui mission, we drove to Pan Xian Special District. The mining pits of the Pan Xian Coal Field are distributed from south to north along the Chang Jiang River Valley. From north to south, there are towns inhabitated by coal miners. Located in the northern end are Tucheng Mining District, population 20,000, and Huopu Zhen, population 19,000. As the river valley is narrow, there is scarcely room for developing cities or towns; thus, most of the residential houses are built on mountain slopes so as to take up as little valuable farmland as possible. Chengguan Zhen is the seat of the Special District Government. Historically, it was a key town on the Yunnan-Guizhou Highway. But when the Guiyang-Kunming Railway was open to traffic and caused the Yunnan-Guizhou Highway to lose some of its status, Chengguan Zhen also became affected and is no longer the busy town as it used to be. Due to its relatively distant location from the chief cities and towns in the mining district, Chengguan Zhen became more and more of a remote town as the coal fields expanded outwards. The future plans are to move the Special District Government to Hongguo Zhen where the land is fairly open and spacious. The location is better and communication with the outside is convenient as well.

As Liupanshui City is, after all, a newborn city, it is still far from perfect in many ways; the sprawling layout of the cities and towns, in particular, has added quite a few difficulties to industrial management as well as supplying of agricultural products and by-products to the urban area. Thus, in the adjustment of the national economy, it is most imperative to stress the characteristics while mapping out suitable plans and helping this new city to move on to vigorous and healthy development.

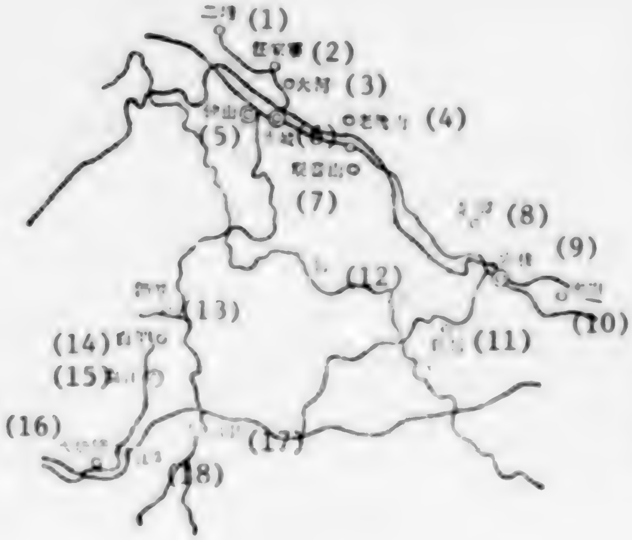

Figure: Map of Liupanshui

1. Ertang
2. Wangjiazhai
3. Dahe
4. Laoyingshan
5. Zhongshan
6. Shuicheng
7. Guanyinshan
8. Yanjiao
9. Liuzhi
10. Mugang
11. Langdai
12. Beipan Jiang [river]
13. Jiuji
14. Baiguo
15. Panjiang
16. Huoshaopu
17. Pan Xian
18. Hongguo

9119
CSO: 4006/135

# Nanwan Mine Exceeds Yearly Plan

Taiyuan SHANXI RIBAO in Chinese 22 Nov 81 p 2

[Article: "Nanwan Coal Mine Tests Two Labor Systems"]

[Text] Trial use of peasant contract labor on the No 1 extraction line of the Nanwan Coal Mine, Pu County, has solved manpower problems and increased output.

The Nanwan Coal Mine started out as a small commune-brigade coal pit. When its management was taken over by the county in 1972, technical reequipping was undertaken, increasing the productive capacity of the shafts to 100,000 tons, but because the mine only had 98 permanent workers it lacked sufficient manpower, which hindered full use of productive capabilities. As a result, it was decided to try using two labor systems. Trial use of peasant contract labor was begun on the No 1 extraction line, making use of excess rural manpower to solve the mine's manpower problem. Initially, consultations were held with communes and brigades in the vicinity of the mine and 100 peasants were recruited as contract workers. Next, with the agreement of the relevant departments, nearly 200 peasants were hired at various times as seasonal contract laborers, increasing the total number of employees at the mine to 395. The hiring of peasant contract labor involved signing of contracts with each of the communes and brigades, specifying the times that work at the mine was to begin and end and stipulating that the contract laborers would respect the mine's labor discipline and accept their assignments, and that while they were at the mine they would be treated as regular workers with regard to wages, labor insurance, welfare and the like. These measures guaranteed relative stability of the mine's manpower levels and enlisted the production enthusiasm of the peasant contract workers.

When this labor force, consisting of persons under 30 years old from the countryside, began work at the mines, they quickly mastered production techniques under the guidance of older workers; some of them were even shift superintendants or brigade foreman, becoming the mainstay of the plant's production technology, enabling the work force on the No 1 extraction line to maintain its youthful vigor, and helping increase output. Last year the plant's total output of raw coal was over 62,000 tons, exceeding the state-assigned production plan. In the first 10 months of this year, the mine has produced an additional 75,000 tons of raw coal, 56 percent higher than the same period last year, has paid 90,000 yuan in profits to the higher levels and has fulfilled its plan for the entire year ahead of schedule.

8480
CSO: 4006/170

## Sichuan Coal Output Increasing

Chengdu SICHUAN RIBAO in Chinese 4 Nov 81 p 1

["Overcome Lax and Flabby Situation, Encourage the Revolutionary Spirit, Production Level of Our Province's Key Coal Mines Continues to Rise"]

[Excerpts] Our province's key provincial level coal mines and above have exerted efforts to overcome the lax and flabby situation. The level of coal production continued to rise in October after hitting the best monthly level in September this year. The production of raw coal surpassed the plan by 8.6 percent, progress in digging footage and tunneling footage also respectively surpassed the plans by 16.8 percent and 28.3 percent.

The production level of our province's key coal mines was able to continue to rise mainly because we conscientiously solved the problem of low morale of the leadership and concentrated our efforts in doing a good job of production. The Daiciba Coal Mine of the Guangwang Mining Bureau did not do a good job of meeting goals during the first 9 months of this year. The main responsible comrades of the mine's party committee carried out self criticism of the problems. They took the initiative in shouldering the responsibility and strengthened unity. Everyone cooperated wholeheartedly, implemented forceful measures, and during the middle ten days of October, average daily production of raw coal reached 500 tons, a sharp increase of 35.5 percent from September.

The leading cadres of each key coal mine conscientiously changed their style of work and visited the grassroots [units] to solve problems. Each bureau and mine organized large groups of cadres headed by the leadership to go to the front line of production to focus on the weak links. During the middle tens days of October, average daily production [at the Zhongliangshen mine] increased from the more than 1500 tons of the past to 2,300 tons. Furong Bureau conducted overall examination of all indicators in implementing the economic responsibility system. During the first ten days of October, daily average production reached 5,672 tons, surpassing the plan by 18.3 percent, total digging and tunneling footage all overfulfilled the plan.

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CSO: 4006/123

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## Datong Coal Output

Taiyuan SHANXI RIBAO in Chinese 16 Oct 81 p 1

[Article: "Tongjialiang Mine Enjoys High Rate of Attendance by Staff and Workers, Plus Frequent Overfulfillment of Coal Production Quota"]

[Text] As the result of enhanced ideological education work among the workers, the Tongjialiang Mine of the Datong Mining Bureau now enjoys high rate of attendance by its workers. From January through September this year, the rate of attendance by its entire staff and workers reached 81.68 percent; the attendance by pit workers reached 78 percent; the rate of attendance by workers of the first excavation line reached 73.59 percent. In the first nine months this year, their output exceeded the quota by a total of over 183,000 tons, and raw coal output was

7.8 percent higher than that of the corresponding period last year, thus attaining the highest level over previous records for the period.

This year, the Communist Party organization at all levels of the entire mine has made every effort to explain to the broad ranks of staff and workers the importance of coal production in the adjustment of the national economy, and the glorious duty incumbent on the coal miners. The educational program has helped the staff and workers to correctly handle the relation between the state and family, develop love for the mine, set roots in the mine, observe rules and regulations, and make more contributions to modernization and construction. A large number of pacesetters for high attendance and great contribution have emerged throughout the mine. The Party Committee has given wide publicity to their exemplary deeds and issued commendations as well; the staff and workers throughout the entire mine are urged to learn from them, thus helping to keep up the rate of attendance of the whole mine.

To maintain the rate of attendance, the whole mine has organized a special monitoring force of more than 160 people with Communist Party and Communist Youth League members as the mainstay. In order to carry out ideological and educational work among the workers and their families, the members on the force penetrate deep into family residential areas, the living quarters of unmarried staff and workers, hospital wards, and conduct heart-to-heart talks with collective groups or separately with individuals. They help the workers solve daily life problems and make proper arrangements for taking home leaves or compassionate leaves. The special force also helps workers of temporary residential status find living quarters and house coal, and assists them in finding schools for their children and medical attention for their families. This has aroused the enthusiasm among the staff and workers in production work, and caused their rate of attendance to increase continuously.

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CSO: 4006/112

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## Pingding County Boosts Production

Taiyuan SHANXI RIBAO in Chinese 30 Oct 81 p 1

[Article by Li Zhenshen [2621 2182 3932]: "Pingding County Commune- and Brigade-Operated Coal Mines Doing Well"]

[Text] The Pingding County Chinese Communist Party Committee has found timely solutions to problems existing in the development of commune and brigade coal mines and has increased raw coal production by more than 100 percent in 3 years. In the first 8 months of 1981, total raw coal production by commune- and brigade-operated coal mines reached 1.25 million tons, exceeding the production of the same period last year by 19 percent.

There is a total of 76 commune- and brigade-operated coal mines in Pingding County and the number of mineshafts that are newly built, enlarged or remodeled in the past 3 years has reached 32.9 percent of existing mineshafts. From building the mineshaft to mining the coal, it is basically done by the same group of people.

From material preparation, to excavation and shaft building, it is all done by their own hands using local materials. Most of the miners are local peasants and even in jointly operated mines only some simple dormitories, offices, warehouses, small messhalls and baths are built. Thus, the investments are low and the results are quick.

The transportation and sale of coal are key problems in the development of commune and brigade coal mines. Since 1980, with the support of railroad and highway departments, the county and communes solved two high-priority problems: (1) With labor from communes and brigades and investments by the coal mines, motor vehicle roads are built from commune-brigade coal mines to main highways. (2) The coal shipping yard at Luanliu Station on the Shi-Tai Line was completed and put into operation in December of last year. By the end of August 1981 a total of 800,000 tons of raw coal from commune-brigade mines had been shipped out, which is equal to 5.7 times the amount shipped in 1978 and exceeds the total amount shipped in 1980 by 60 percent. Because of good highway transportation, shipment by railroad had increased. Up to the end of August 1981 the communes and brigades exported 1.15 million tons of raw coal, or 10.5 percent more than the total annual export of 1980. At the end of August, the entire county had only 310,000 tons of coal storage, 87 percent less than the coal storage in the same period of last year.

Prior to 1980, the management of commune and brigade coal mines was chaotic, major incidents occurred frequently and production efficiency was low. Taking aim at these problems, the County Committee and other departments concerned consolidated the commune and brigade coal mines and widely established a responsibility system. Also, on the basis of overall planning, phasing out old mines year by year and thoroughly correcting unplanned mining, 10 commune and brigade mines were remodeled and enlarged with priority investment funds. In order to make effective use of capital, technical and labor resources and professional cadres, and to increase the revenue of communes and brigades without coal mines, a number of joint operations were adopted including county-commune-brigade joint operations, commune-commune joint operations and brigade-brigade joint operations. Today there are 6 upgraded commune and brigade coal mines with design capacities in the 200,000 - 300,000-ton-per-year range.

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CSO: 4006/129

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## 'Honeycomb Coal' Helps Reduce Pollution

Taiyuan SHANXI RIBAO in Chinese 3 Nov 81 p 2

[Article by Dai Yunzheng [2071 0061 5544] and Xiao Qingyi [5135 3237 4135]: "Popular Use of 'Honeycomb Coal' Has Many Advantages"]

[Text] Broad use of "honeycomb coal" has great advantages in conserving energy, reducing pollution and making the public's life convenient. Measurements made by the departments concerned show that each year Taiyuan Municipality releases 330,000 tons of dust and 500,000 tons of carbon dioxide into the atmosphere, making it one of the most seriously polluted cities in China.

Air pollution in Taiyuan mainly stems from the bituminous coal stoves in thousands of households. More than 70 percent of the emissions from bituminous coal are poisonous, whereas "honeycomb coal" has less than 30 percent poisonous emissions. Besides, the use of "honeycomb coal" in cities and towns will remain significant even after coal gas becomes available. Today, many provinces and municipalities are vigorously pushing the use of "honeycomb coal". For example, more than 90 percent of the urban households in Xi'an, Zhengzhou and Shijiazhuang are using "honeycomb coal". Therefore, the effort of popularizing honeycomb coal among the residents of Taiyuan Municipality must be coordinated in conjunction with the promotion of coal gasification.

At present, residents of Taiyuan have two channels of access to honeycomb coal: one is the machine-made honeycomb coal carried by commercial departments and the other is the machine-made honeycomb coal processed by plants and mining enterprises for their employees. According to estimates by departments concerned, even if the 400,000-ton coal coking plant to be built by the Taiyuan Coal Gasification Company can go into production and deliver coal gas by the end of 1984 on schedule, the number of households using coal gas will be no more than 30 percent of the total. The other 70 percent of the households should use honeycomb coal. From an economic point of view, if there are 130,000 households in Taiyuan using honeycomb coal, each year there will be a saving of 144,000 tons of coal at a value of 2.6 million yuan and there will be 33,000 tons less garbage at a saving of 890,000 yuan and 400 jobless people can be employed.

There are many difficulties to overcome in the popularization of honeycomb coal. We therefore present the following suggestions:

1. The development of coal gas should be planned in coordination with the popularization of honeycomb coal. The development of honeycomb coal should serve the development of coal gas. The production and supply network in commercial departments should be planned at the same time as well.

2. Construction capital and price differential compensation problems must be solved properly. In the past few years, honeycomb coal popularization investments granted to Taiyuan Municipality by the state, provincial, and municipal environmental protection bureaus are all in the several hundred thousand to several million yuan range. In the future, the spending of these investments should be concentrated. For commercial outfits, carrying honeycomb coal is a business that loses money, each year they should be given subsidies for the coal price difference. As soon as production is improved and the economic responsibility system is completely established, it will be entirely possible to cut loses and reduce subsidies.

3. The supply of raw materials must be properly arranged. The principal material source for honeycomb coal production in Taiyuan today is the mixed coal from Yangquan. From now on, in addition to getting more mixed coal from Yangquan, the problem of major supply sources should be solved according to the principle of using local or nearby materials. The solution could be found in the low sulphur content and low vaporization coal produced in nearby Gaobai in Qingxu County. Also, coke cinders produced by the Taiyuan Chemical Fertilizer Plant should be used as much as possible as a partial substitute for raw coal.

4. Management methods should be improved to increase the honeycomb coal quality. Pricing by jin should be changed to pricing by block, and a delivery service should be organized for the public's convenience. The direction of effort for manufacturing choice honeycomb coal is in the variety of product type and specification and in the multiple purposes of their use.

9698
CSO: 4006/129

## More Coal to Hong Kong, Macao

HK180705 Hong Kong TA KUNG PAO in Chinese 16 Jan 82 p 1

[Dispatch from correspondent Hou Tung-hai [0186 2639 3189]: "Southwest China's Coal Will be Shipped to Hong Kong and Macao"]

[Text] Beijing, 15 Jan--Today, at the inaugural meeting of the China Southwestern Energy Department Corporation, a new joint venture formed to develop the nation's natural resources, our correspondent had an interview with Gao Yangwen, chairman of the board of this corporation and minister of the coal industry, and asked him to say something on occasion to the industrial and financial circles in Hong Kong, Macao and other overseas Chinese. He said, Hong Kong's TA KUNG PAO reported last November on the preparations by the China Southwest Energy Department Corporation. Since then, many companies and people in Hong Kong, Macao and other countries have shown great interest in the coal resources in the Liupanshui area of Guizhou Province. Quite a few friends in industrial and financial circles also expressed their willingness to make contributions to the exploitation of the natural resources and the economic development of the southwestern part of the motherland. We highly appreciate this attitude.

### The Corporation Will Export 400,000 Tons of Coal This Year

Gao Yangwen said: There are rich coal and other natural resources in the southwestern part of our country. Speeding up the exploitation of these resources will be of great significance to the prosperity of this area and the economic construction of our country. Meanwhile, if the transportation facilities are improved, it will be easier to transport a large quantity of coal and other resources to Hong Kong, Macao and the Southeast Asian countries. This will undoubtedly be good for their economic development. In exploiting the natural resources in the southwestern provinces, we shall make ample use of foreign funds in extensive cooperation with our compatriots in Hong Kong, Macao and Taiwan, as well as the overseas Chinese. We shall offer preferential treatment to them.

Gao Yangwen expressed a warm invitation to friends from all circles in Hong Kong, Macao and other countries to come for a visit or an on-the-spot investigation in the southwestern part of our country. He said that this corporation will provide them with all facilities.

General Manager Will Arrive in Hong Kong This Month

In conclusion he said that from this year on, this corporation will provide Hong Kong and Macao with coal, and the quantity will be increased year after year. In order to establish more extensive contact with the people in various circles in Hong Kong, to make a direct investigation of the demands of the Hong Kong market and some major customers, to know better the transportation situation in Hong Kong harbor and to explore avenues for further cooperation, a seven-person delegation led by Li Lu, general manager of this corporation, will arrive in Hong Kong this month.

CSO: 4020/84

## Briefs

GUANGDONG COAL OUTPUT--Guangdong's coal output has been increasing month after month in the second half of this year. In October the output was more than 726,000 tons, which was 103,600 tons over the original plan and topped this year's record. In the first 10 days in November, the output registered another increase of 12.4 percent over the same period of last month. In addition to more investment in Guangdong's coal production this year, various responsibility systems have been carried out, thus promoting the continuous increase of coal production. By the end of October, the output of the local mines in Guangdong had already exceeded the annual plan. Mines in Foshan and Zhanjiang prefectures as well as county-run mines in Shaoguan and Zhaoqing prefectures, and the Baokeng mine in Shantou prefecture have fulfilled this year's plan 2 months ahead of schedule. The output of the Hong Kong and Meitian mines, which was previously low, has also greatly increased. [ZHONGGUO XINWEN SHE in Chinese 0212 GMT 24 Nov 81 HK]

HEILONGJIANG OVERFULFILLS QUOTA--Harbin, 18 Dec (ZHONGGUO XINWEN SHE)--Heilongjiang Province, one of the key coal production areas in China, had produced 32 million tons of raw coal by 16 December and has overfulfilled its yearly production quota for 7 consecutive years. It also fulfilled its tunnelling quota 1 month ahead of schedule. Heilongjiang Province abounds in coal deposits and has developed coal production very quickly. At present, it occupies the third place in the whole country. Here, the quality of coal is excellent and this coal generates a high amount of heat with a low amount of carbon substance and strong coking power. A portion of this raw coal can be coked without the process of being dressed with water. This province is a famous main coke production base in China. There is a substantial variety of coal. More than 20 kinds of by-products can be extracted from this raw coal, namely, coal gas, coal tar, essence, and so on. The coal which is produced here is not only supplied with the country but also exported to some countries in Asia. [Text] [Beijing ZHONGGUO XINWEN SHE in Chinese 1019 GMT 18 Dec 81]

HUNAN COAL PRODUCTION QUOTA--By 31 December 1981, the coal mining system of Hunan Province had overfulfilled the year's coal production quota of 20 million tons. In the first 8 months of 1981, there was a shortfall of output. Since September, leaders of the coal mining system at all levels had led some 1,000 cadres to the frontline to assist the work and promptly solve the problems of production. They also practiced various forms of production responsibility systems and overcame egalitarian practices. From then on, production of coal increased. The provincial coal mining system maintained an average output of 26,000 tons of coal per month for 4 successive months, which was an all-time record. The provincial coal mines fulfilled the year's state quota 2 days ahead of schedule. The coal mines of prefectures and counties and the small coal mines of communes and brigades have also fulfilled the year's quota. [Changsha Hunan Provincial Service in Mandarin 2310 GMT 31 Dec 81 HK]

LIAONING COAL OUTPUT--The collieries throughout Liaoning Province whose products are distributed under the unified state plan prefulfulled their annual production plan by 4 days. Their total raw coal output was 28.02 million tons. These collieries also prefulfilled their annual plans for dressing coal, exploration footage and strip mining excavation respectively by 23, 13 and 17 days. [Shenyang Liaoning Provincial Service in Mandarin 1100 GMT 28 Dec 81 SK]

LIAONING LOCAL COLLIERIES--As of 30 November, local collieries in Liaoning Province had produced 4.23 million tons of raw coal, overfulfilling the annual production plan ahead of schedule. Workers and staff members of local collieries are determined to produce 450,000 more tons of raw coal by the end of 1981. [Shenyang Liaoning Provincial Service in Mandarin 1100 GMT 2 Dec 81 SK]

LIAONING COLLIERY--The (Tiefa) Colliery, one of the state's major projects, has been partially completed in Liaoning Province. The colliery has a deposit of 2.2 billion tons of coal, 30 percent of the total deposit in the province, buried under an area of 580 square kilometers. Five out of the colliery's seven large pits have been put into operation. By end of this year, projects under construction with a capacity of producing 4 million tons of coal will be completed. The designed annual capacity of the whole mining area is 13 million tons. As of now, the colliery has produced 24 million tons of coal, equivalent to 400 million yuan of output value--near the total investment by the state. With highways and railways radiating out in all directions, the colliery connects Shenyang municipality and the Qinghe Power Plant, China's biggest thermal power plant, and includes workers dormitories, schools, stores, hospitals and clubs. [Shenyang Liaoning Provincial Service in Mandarin 1100 GMT 2 Oct 81 SK]

NEI MONGGOL COAL PRODUCTION--Leading cadres and all the employees of the Nei Monggol unified distribution coal mine made a vigorous push in August and September and increased raw coal production by 230,000 tons, not only making up deficits of the previous 7 months but overfulfilling the quota by 2,000 tons. In order to turn around the passive situation in coal production as quickly as possible, director and deputy director of Nei Monggol Coal Management Bureau led one-third of the bureau cadres, formed a working group, visited the mining bureaus with the most deficits and helped them in their work. Leading cadres of mining bureaus and mines also went to the frontline of production, took the responsibility for some mining surfaces and worked in shifts. [Text] [Beijing RENMIN RIBAO in Chinese 30 Oct 81 p 2] 9698

NEI MONGGOL COAL OUTPUT--Nei Monggol autonomous region has scored good achivements in coal production this year. By 17 December, the region had prefulfilled its annual coal production plan by 14 days and fulfilled its annual quota of 20.03 million tons of coal. The regional annual plan for coal exploration footage was fulfilled in mid-November. By the end of 1981, the region is expected to have a 500,000-ton surplus of raw coal. [Hohhot Nei Monggol Regional Service in Mandarin 1100 GMT 20 Dec 81 SK]

NINGXIA COAL DELIVERY--Due to insufficient railway transportation facilities, some 957,000 dun of coal in the Ningxia Hui autonomous region was awaiting to be delivered to other localities as of the end of October. [Beijing Domestic Service in Mandarin 1600 GMT 10 Nov 81]

SHANDONG COAL OUTPUT--Shandong Province had overfulfilled the 40-million-ton 1981 coal output plan by 10,000 tons as of 29 December. The annual plans for dressed coal output and tunneling footage were prefulfilled by 3 and 20 days, respectively. Because of the many coal pits whose output is distributed under a unified state plan that became exhausted and were abandoned this year, there are 16 fewer coal pits in operation in the province this year than in 1980. Total footage was 1,663 meters less than in 1980. [Jinan Shandong Provincial Service in Mandarin 2300 GMT 29 Dec 81 SK]

SHANDONG COAL MINE--The headquarters of the Yanzhou coal mining area held a celebration rally 21 December and announced that Xinglong Zhuang coal mine, the first modernized coal mine in China, is now in production. Construction of this coal mine, with an annual capacity of 3 million tons, began 20 February 1975 and was completed 12 July 1981. After being tested, this coal mine proved satisfactory. The State Examination and Acceptance Commission recently held a meeting to examine this coal mine and agreed that the test operation was up to standards. (Wang Deying), vice minister of the State Capital Construction Commission; Li Jianping, vice minister of the coal ministry; and Song Yimin, deputy governor of the Shandong Provincial People's Government, attended the rally. [Jinan Shandong Provincial Service in Mandarin 2300 GMT 21 Dec 81 SK]

SHAANXI COAL PRODUCTION--By 10 October, local coal mines in Shaanxi Province had produced 4.89 million tons of raw coal. They have overfulfilled their quotas for production of raw coal for this year 80 days ahead of schedule. [Xian Shaanxi Provincial Service in Mandarin 1130 GMT 22 Oct 81 HK]

OCTOBER PRODUCTION--By 29 October, coal mines in Shaanxi Province had overfulfilled their quotas for production of raw coal for October by 14,700 tons. Output of raw coal from 1 to 29 October was 18.4 percent more than in the corresponding period of September. [Xian Shaanxi Provincial Service in Mandarin 1130 GMT 1 Nov 81 HK]

PRODUCTION INCREASES CONTINUE--In November, Tongchuan Mining Bureau produced some 578,000 tons of raw coal, overfulfilling the state quota by 3.4 percent. As a result, the mining bureau increased its income by some 600,000 yuan. Twelve of the 13 pits overfulfilled their production quotas. The average daily output of raw coal of (Dongpo) coal mine which won the first place in production emulation is some 1,800 tons, 35 percent more than the planned daily output. [Xian Shaanxi Provincial Service in Mandarin 0500 GMT 6 Dec 81 HK]

JANUARY COAL OUTPUT--Shaanxi coal mines under the control of the central authorities produced 351,120 tons of coal in the first 10 days of January, 19.8 percent more than in the same period of last year. This included 202,000 tons produced by Tongchuan Mining Bureau. [Xian Shaanxi Provincial Service in Mandarin 2300 GMT 15 Jan 82 HK]

TAIYUAN COAL STORAGE--The giant coal storehouse newly built by the Taiyuan City Fuel Company in Xuxi Zone of the Southern Suburb is now completed and available for use. The storage area measures some 48,000 square meters; its maximum capacity is more than 100,000 tons; it is equipped with special railway lines, and employs huge unloaders. When in full service, the storehouse will handle up to approximately 40 to 50 percent of Taiyuan's current household coal consumption which will not only reduce pollution in the city and thus help keep the city clean, but also upgrade the efficiency of the loaders and reduce the work intensity of loading operation workers. Moreover, it is conducive to the storage, preservation and immediate supplying of coal. [Text] [Taiyuan SHANXI RIBAO in Chinese 16 Oct 81 p 1] 9119

SHANXI INCREASES OUTPUT--According to the provincial departments concerned, Shanxi produced over 130 million tons of coal in 1981, accounting for 20 percent of the national total. The province has boosted output by 10 million tons in each of the past 5 years. Output in 1981 was 52.8 million tons greater than in 1976. Mines of all sizes have contributed to this success. [Taiyuan Shanxi Provincial Service in Mandarin 2300 GMT 14 Jan 82 HK]

SHANXI COAL PRODUCTION--Taiyuan, 19 Jan (XINHUA)--One-fifth of China's coal come from Shanxi Province, according to the Provincial Coal Department. The province's coal output, which now stands at 130 million tons, has been rising at an annual rate of ten million tons over the past five years, the department said. Compared with 1976, last year's coal output of state-owned coal mines was up 17 million tons and at coal mines run by localities and people's communes up 36 million tons. The province's coal deposits have been verified at more than 190,000 million tons, accounting for one third of the country's total verified reserves. Coal mines with a total annual production capacity of 27 million tons have been under construction since 1980. Improvement of existing mines raised the province's production capacity by 4.8 million tons in the last five years. [Beijing XINHUA in English 0252 GMT 19 Jan 82 OW]

CSO: 4006/162

OIL, GAS PROSPECTS FURTHER ASSESSED

## National Coal Gas Symposium

Beijing DIZHI LUNPING [GEOLOGICAL REVIEW] in Chinese Vol 27, No 6, 1981 p 549

[Article by Wang Kaiyu [3769 7030 1342], Secretarial Group, Petroleum Geology Committee, China Geological Society: "Experts Gather in Yangzhou in Spring To Discuss 'Coal Gas'"]

[Text] On 26-30 May 1981, the Petroleum Geology Committee of the China Geological Society, the Jiangsu Province Geological Society and the Jiangsu Province Petroleum Society jointly organized a "National Academic Symposium on Coal Gas" in Guazhou Zhen [Town] of Yangzhou City, Jiangsu Province. At the meeting were some 80 representatives from more than 40 organizations under the Ministry of Geology, Ministry of Petroleum, and Ministry of Coal, as well as the Chinese Academy of Sciences and schools of higher education. It was China's first special symposium on coal gas.

Some 20 papers were exchanged and discussed during the five days. The representatives freely expressed their views, and they were all delighted to have the opportunity to meet people with different academic viewpoints and opinions, and receive encouragement from many comrades-in-arms in the coal gas area.

The symposium focused on the concept and origin of coal gas, as well as the position of coal gas among the various natural resources. "Coal gas" is actually the abbreviated form for natural gas generated from coal-bearing metamorphic strata or from coal series. As the term is too long, we now use the word "coal gas" which has come into popular use in recent years. It is generally believed that the natural gas in coal-bearing strata exists in three forms: free state, dissolved state and adsorbed state, much of it (about 90 percent) is in the adsorbed state. Besides coal layers, large quantities of scattered coal-bearing substances can also generate coal gas. To determine the gasification capacity of coal layers, laboratory tests and computations indicate that one ton of lignite coal can generate 30-40 cubic meters of methane in the process of transforming into long flame coal, or 70-80 cubic meters of methane as it transforms into fat coal, or 120-125 cubic meters of methane as it changes into lean coal, or 200 cubic meters of methane when it transforms into carbonaceous coal. The coalification and transformation of coal are similar to petroleum. Thus, to a certain extent, oil and gas can be generated in the process of coalification, and natural gas is, of course, the chief kind of gas produced due to the fact that coal source material is humic organic matter while petroleum source material is sapropelic organic matter. The presence of petroleum in coal series is quite common and widely distributed, but of low yield. On the other hand, natural gas is found in many large gas fields.

As a component of flammable natural gas, coal gas holds great prospects. But work in this area is only in the preliminary stage. It is necessary to strengthen research on basic theories (such as the composition, evolution, characteristics and emission mechanism of coal gas) and the geological conditions of coal basins (gasification substances and preservation conditions). Moreover, coal gas work should be stepped up in Sichuan, Shanxi, Ordos "basin in Shaanxi Province], and other areas of China so as to accumulate experience and thus serve as guidance for future coal gas general surveys.

In recent years, the growth rates of the world's natural gas reserves and production have greatly exceeded those of petroleum. In 1980, the growth rate of natural gas reserves was approximately three times more than petroleum, which is related to the fact that natural gas in many large gas fields originate from coal seams. For example, there are very large gas fields in the southern portion of the North Sea and Siberia which produce coal gas. According to a report, approximately 65 percent of the natural gas in the Soviet Union originates from coal series. In view of the worldwide declining oil reserves and production, it is extremely imperative to look for natural gas, which is inexpensive and causes fewer pollution problems. At present, China's natural gas reserves are only 0.25 percent of the world's total reserves, and China's output is merely one-forthieth of the United States. But our country has rich coal resources; there are 640 billion tons of proven reserves and the prospective reserves are expected to reach 4.2-5 trillion tons, which is bound to give rise to a considerable amount of coal gas. There should be 6-7 trillion cubic meters of coal gas resources in this country if we base computation in terms of layers over 2,000 meters deep. Thus, it is of great strategic importance to energetically develop coal gas general surveys. The representatives at the meeting agreed that it is of great urgency to adopt coal gas as a major energy source and immediately carry out general surveys in our country. At the seminar, some papers even dealt with the relation between coal gas and petroleum, and presented comparative analyses of the similiarities and differences between their survey methods; some papers examined such problems as the computation of coal gas reserves, ways of conducting coal gas research, etc.

As the preparatory work was carried out in haste, the number of papers presented at the seminar was not adequate. Nonetheless, the representatives felt that the meeting was a good beginning and constituted the basis for future advances; to a certain extent, it is bound to promote coal gas research in our country. The representatives at the seminar urged the concerned societies to carry on with organizing and coordinating academic exchanges in the area of coal gas, which will enable China to develop its energy resources in a flexible and diversified manner, and put an end to the current shortage in reserve energy resources as soon as possible.

9119
CSO: 4006/203

# Tarim Plate Prospects Analyzed

Beijing SHIYOU KANTAN YU KAIFA [PETROLEUM EXPLORATION AND DEVELOPMENT] in Chinese No 3, 1981 pp 1-9, 59

[Article by Wang Yichang [3769 1355 2490] and Tan Shidian [6223 6107 0368], Office of Geophysical Exploration, Ministry of Petroleum: "Evolution and Oil-Gas Prospects of the Tarim Plate Structure"]

[Text] ABSTRACT. The theory of plate tectonics is applied to a preliminary analysis of the historical development of the Tarim Basin and it is concluded that in an early period it belonged to an outer-arc basin, while in the Cenozoic period it changed into a submontane collision basin. On the basis of geological and physical exploration data, the basin is divided into seven structural units, namely the Kucha Downwarp, the North Tarim Uplift, the East Tarim Downwarp, the Bachu Uplift, the Southwest Downwarp, the Tanggubasi Downwarp and the Southeast Uplifted Fault Block. Oil has already been found in the Southwest and Kucha Downwarps; of the others, the East Tarim Downwarp has a large area, its Neogene strata are rather thin, there is a variety of structural types, and in addition it belongs to a mantle uplift area which may have a rather high heat flux value, all of which are favorable circumstances for the development and evolution of oil and gas, so that this is a suitable area for oil-gas exploration.

The Tarim Basin is located in the geosynclinal folded belt between the Tianshan and Kunlun Mountains and has an area of about 560,000 square kilometers, making it our country's largest Mesozoic-Cenozoic sedimentary basin. Owing to geographical conditions and the limited amount of exploration that has been done, there is considerable diversity of views on a number of geological questions related to the basin. Using many years' geological and geophysical exploration data, this article attempts to study the basin's geological history and structure in terms of the theory of plate tectonics in order to aid the search for oil and gas.

## 1. Characteristics of the Tarim Basin Regional Magnetic Field

The Tarim paleoplate was previously called the "Tarim Platform." There are a number of Archean and Proterozoic outcrops around its margin, but the extensive interior has been analyzed primarily through regional aeromagnetic data. Analyzed against the regional geological background, the spatial distribution of the regional magnetic anomalies should prove to result from differences in original rock structures and from different processes of development in the crystalline basement rock.

The features of the Tarim Basin regional magnetic field are extremely clear-cut. It consists of five main sections: 1. the southern magnetic field area, which is an area of gradually alternating north-south positive and negative anomalies; 2. the central magnetic high, an east-west magnetic anomaly over 1,000 kilometers long but only 60 to 80 kilometers wide, passing through the center of the Tarim Basin; 3. the northern magnetic field area, a slowly-varying negative anomaly;

4. the Aerjin piedmont magnetic field area, a local anomaly area in the Minfeng-Ruoqiang area in the south, bounded by a northeast-trending string of anomalies; 5. the Bachu magnetic field area, a north-south field with strong interference, located in the Bachu area in the northwestern part of the basin.

If the $\Delta T_A$ anomaly is reduced to the pole and a 20-kilometer upward continuation calculation made, the last two field areas mentioned above disappear, indicating that they are produced by near-surface features. In terms of geological data, they can be explained as anomaly zones in which eruptive or effusive rock is distributed along fractures.

## 2. Evolution of the Ancient Tarim Plate

Using a combination of geological and geophysical data [1-5], the developmental history of the ancient Tarim Plate can be divided into several stages, as described below.

Archean Period. The southern Tarim basin was a gneiss system containing hornblende-granulite facies, which attains a thickness of more than 8,000 meters at Tiekelike. It was formed by eugeosynclinal which underwent numerous complex structural changes, were folded into northeast-trending structures and formed an ancient continental nucleus, thus beginning the initial stage of development of the ancient plate. The mid-Tarim translithospheric fracture may be an area in which Archean and early Proterozoic paleoblocks descended, comparable to the area of descent of the North China block and the northern margin of the Inner Mongolian island arc.

Middle and Lower Proterozoic. A structural magma belt appeared in the Aksu-Kuruk Tagh region of the northern Tarim basin, forming an island arc. On the south side of the island arc was the Aksu greenschist group, while on the north side was the Tianshan eugeosynclinal belt, which descended toward the south; this subduction belt was on the northern edge of the Kuruk Tagh mountains. Along the southern margin of the Tarim ancient continental nucleus, the western Kunlun eugeosyncline descended toward the north in the Sailatu region, producing a middle and lower Proterozoic magma arc. During the period the ancient continental nucleus was growing considerably and the continental crust was thickening over an extensive area, producing the rippled character of the ancient Tarim plate. The Aerjin transform fault began activity, delimiting the southeastern boundary of the ancient plate.

Upper Proterozoic. Stable sedimentation occurred in the Kuruk Tagh belt; the northern part, consisting of spilite-keratophyre eugeosynclinal sediments, continued to descend southward along the early and middle Proterozoic subduction belt. Within the plate, in the vicinity of Keping there are only upper Sinian sediments, which represent a standard type of stable sediment. The Western Kunlun Mountains along the southern margin were a eugeosynclinal trough (upper Yarkand River area), which continued to descend toward the north, while the leading edge within the plate was an outer-arc basin consisting of a set of shallow marine sediments. The Aerjin piedmont area consists of stable, thick carbonate sediments, making it clear that the Aerjin transform fault played a clear controlling role.

Lower Paleozoic. In the Cambrian and Ordovician periods, the Tianshan mountains were primarily a miogeosyncline, and active sedimentation occurred only between the areas west of Kumishi and north of Anxi, reaching a thickness of more than 7,000 meters. In the Silurian period, the eugeosyncline expanded northward, attaining a thickness of more than 6,000 meters. A Caledonian magmatic arc occurred in the upper Aksu River region, and the marine crust descended toward the south; the subduction belt was along the northern edge of the Haerkewuta Mountains, and may have extended westward as far as the Alamutu region of the Soviet Union; in the western section many areas of ultrabasic rock appeared. Within the plate occurred pelagic carbonates and shallow-sea sediments, while in the Keping area there were lagoon sediments 1700-6500 meters thick. In the early Paleozoic, the Western Kunlun Mountains were a miogeosyncline, which began to descend at the end of the Caledonian movement. During this period, the Aerjin transform fault played a clear controlling role, dividing the Qi-Kun geosyncline from the Western Kunlun geosyncline.

Upper Paleozoic. This was a period of intense activity of the Western Kunlun and Tianshan geosynclines at the south and north respectively of the ancient Tarim plate. The Tianshan eugeosyncline gradually shifted northward; the Devonian sedimentation belt is in the vicinity of Kumishi, while the Carboniferous eugeosyncline is located in the vicinity of the northern Tianshan and Dzungarian areas, with a thickness of more than 10,000 meters. Transitional sediments already appear in the central Tianshan area.

During the early Variscan movement, the marine crust descended sharply in the direction of the ancient Tarim plate, and along this subduction zone there are large amounts of ultrabasic rock in the line from the Keluolu Mountains to Xingxing Pass. In the middle Variscan period, the sea contracted and became closed off and the expanded northern margin of the Tarim plate converged with the southern margin of the ancient Siberian plate, forming a suture belt in the Kelameili area [4]. Because the Tianshan geosyncline descended toward the south, an outer-arc basin running nearly east and west appeared on the northern margin of the plate. The Western Kunlun Mountains developed into a eugeosyncline on top of the Caledonian miogeosyncline, and descended toward the north along the ancient magma arc, so that the Proterozoic magma arc was super-imposed on the Variscan magma belt, while the southwestern margin of the Tarim plate became an outer-arc basin. In this way, during the Variscan movement the ancient Tarim plate developed into a clearly-defined double arc outer-arc basin, while late Paleozoic downwarps developed to the north and south. Because of the collision of the northern and southern marine crusts, the northwest-facing Bachu uplift and fracture began to develop within the plate. The activity of the Aerjin transform fault intensified, and magma activity occurred. Devonian sediments from this period within the plate consist primarily of terrigene red clastics 400 to 2,000 meters thick. During the Carboniferous period, the sea engulfed nearly the entire region. There was a shallow-sea platform facies in the Bachu area, and tidal or nontidal lagoon facies appeared; carbonate rock with intercalated sandstone and mudstone occurred on the southwestern margin and in a large area in the northern part of the block. There were numerous organisms and a rich supply of organic matter, so that it was an excellent oil-producing environment, with a thickness of 600 to 1,000 meters. In the early Permian there was a regressive movement, although there was still mudstone and limestone on the southwestern margin, with a thickness of over 1,000 meters; in the other areas there were primarily continental clastic rocks. In the Bachu uplift, effusive basalt became distributed along the fracture, and sediments consisted of late Permian red clastics; the area had a rift valley character. Late Permian molasse structures occurred over an extensive area in the Tianshan geosynclinal folded belt, foreshadowing the end of the Variscan movement.

Mesozoic. Initially, because of the closing off the Tianshan geosyncline, most of the area within the plate underwent uplifting and erosion, except in the Kucha region where there was a piedmont fault depression in which more than 1,200 meters of Triassic continental clastics accumulated. The Jurassic system occurs extensively, but it is still of a fault-depression character, and coal-containing series more than 3,000 meters thick have accumulated in it. The East Tarim and Tanggubasi fault depressions began to develop; these generally contain about 2,000 meters of coal-containing strata. Because the Karakoram Mesozoic eugeosyncline descended northward at the southwestern edge of the ancient Tarim plate, outer-arc basin characteristics still remain in the Kashgar area, and 300 meters of coal-containing structures and red clastic structures have precipitated in the fault depression. During the Cretaceous period the ancient Tethys Sea entered the Southwest Downwarp through the Alai Strait, further expanding the sedimentation area; the Tanggubasi trough may have been joined to the southern and northern downwarps. The thickness and extent of the Mesozoic sediments within the basins are shown in Fig. 1.

Cenozoic. During the Eocene, the transgressive process continued in the Southwest Downwarp, and it is reported that the sea may have reached the eastern Tarim area and the Keping and Mingan areas. With the exception of the Bachu uplift, there is extensive Eogene sediment, 1,000-1,500 meters thick, throughout the area.

In the Middle Cenozoic, because the Indian Ocean plate collided with the Chinese continental mass, the Tarim region was affected by the upthrust of the Pamirs, and the seas gradually receded. In the Noegene, the Indian Ocean plate moved violently northward, causing the Tianshan and Kunlun mountains to be reactivated and undergo abrupt uplifting; old fractures on the margin of the Tarim plate continued their activity and new ones were produced, resulting in a network consisting of two sets of fractures, running northwest and northeast. Most of the areas within the plate settled and 5,000-7,000 meters of Neogene-Quaternary molasse structures accumulated in the northern section and the southwestern piedmont region, while 2,000-3,000 meters of red clastic structures were laid down in the central part of the basin, forming the present-day relief (see Fig. 2).

## 3. Structure of the Tarim Basin

The general outline of the crustal structure of the Tarim basin is shown in Fig. 3. The crust is the thinnest, abcut 40-43 kilometers thick, in the central and northern sections and on the lower Tarim River, this is an area of arching of the mantle. Variations in crustal thickness within the basin are not large; the gradient is only 14-40 meters per kilometer, although it becomes larger at the margins. The area is surrounded by the cis-Kunlun Depth Fracture, the Aerjin Depth Fracture, the Northern Kuruk Tagh Depth Fracture and the cis-Tianshan Depth Fracture, and is spindle-shaped.

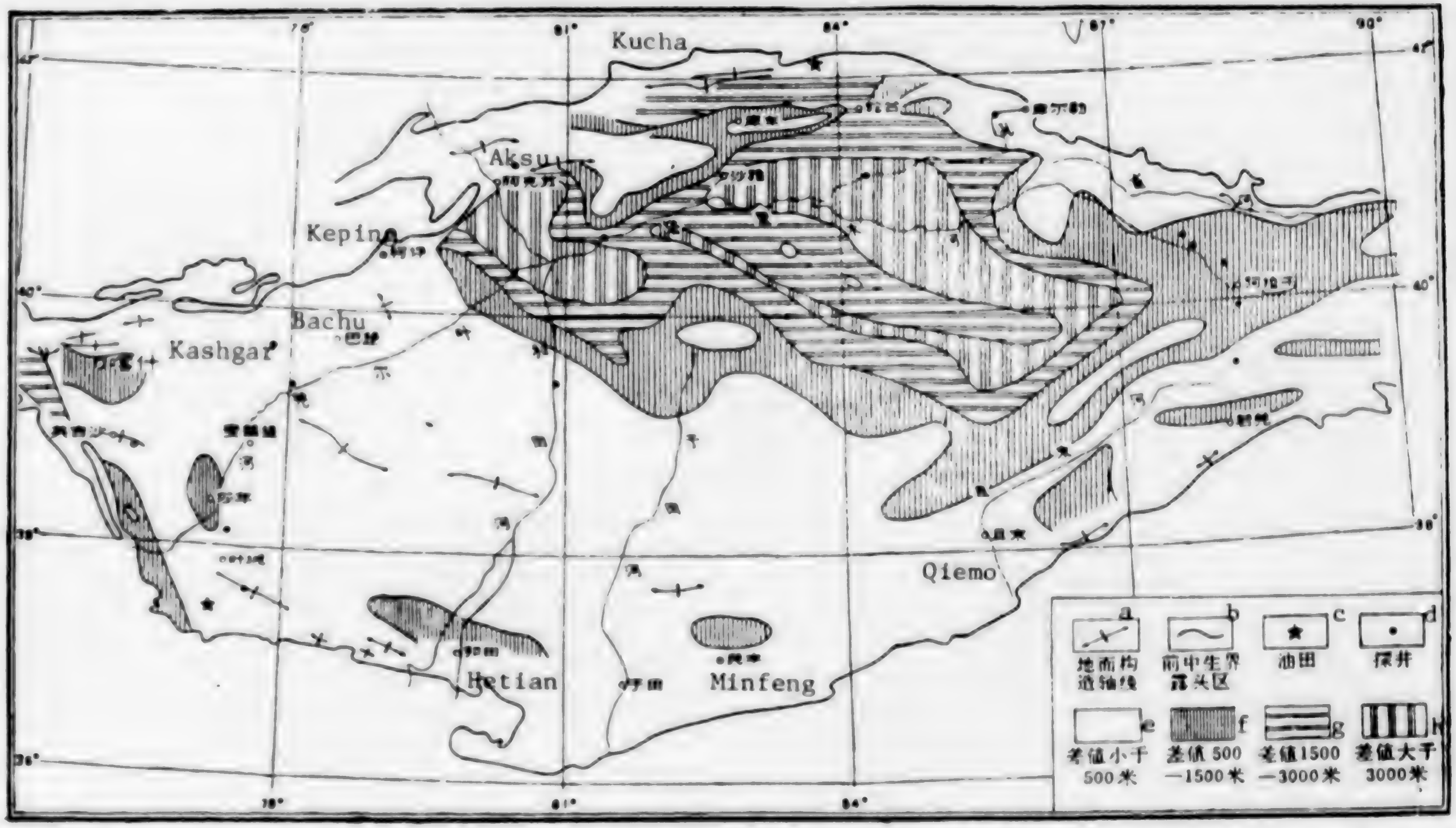

Fig. 1. Difference in depth between the bottom of the Cretaceous system and the density discontinuity boundary in the Tarim basin

Key:

a. Surface structural axes
b. Areas of exposure of pre-Mesozoic features
c. Oilfields
d. Exploratory wells
e. Difference less than 500 meters
f. Difference between 500 and 1,500 meters
g. Difference between 1,500 and 3,000 meters
h. Difference greater than 3,000 meters

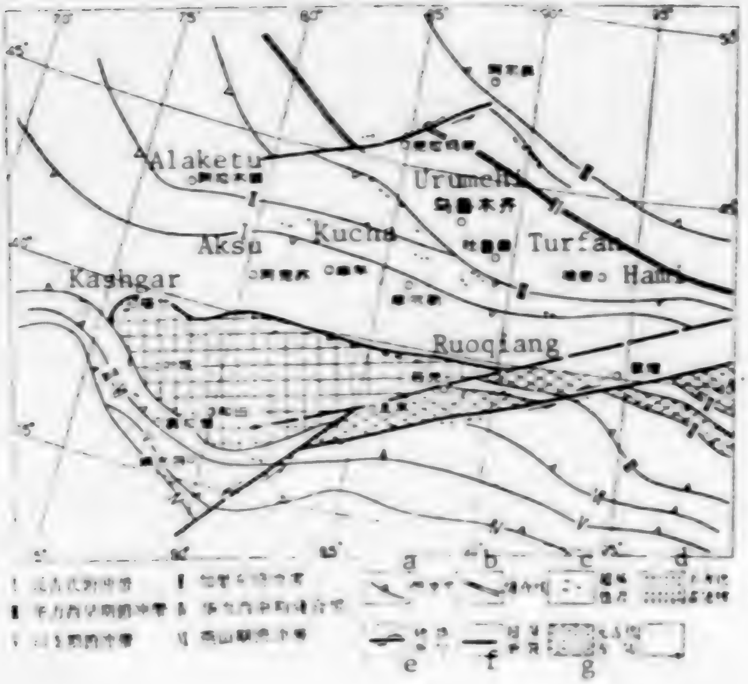

Fig. 2. Development of the ancient Tarim plate

Key:

- I. Archean subduction belt
- II. Caledonian subduction belt
- III. Early Variscan subduction belt
- IV. Middle Variscan suture belt
- V. Indo-Sinian subduction belt
- VI. Yanshanian subduction belt

- a. Subduction belts
- b. Sutures
- c. Ultrabasic rock
- d. Archean continental nucleus
- e. Transform faults
- f. Depth fractures
- g. Archean protocontinent

The gravity anomaly which remains after large-area correction and correction for the different rock characteristics is a composite value reflecting the relief of the top of the Carboniferous-Permian limestones and various sedimentary strata. The east-west structural line in the vicinity of Kuerle-Aksu in the north of the basin is still under the influence of the Proterozoic east-west structural magma belt, while the Minfeng-Qiemo area in the southeast of the basin is influenced by the Aerjin northeast-running transform fault. In most of the central part of the basin, a structural line running northwest is the predominating one, reflecting the results of the abrupt plunging of the northern and southern marine crusts toward the Tarim plate during the late Variscan movement, which produced the overall framework of a rhombic fault block structure oriented primarily toward the northwest.

If we use the variable-density iterative curve-fitting method to calculate the depth of the density change boundary, cancelling out the density differences between sedimentary layers so that the gravitational value is correlated directly with the relief of the top of the limestone strata, the computation accuracy is improved and we obtain an idea of the "size" of the basin structure relief. If we then combine the results with other geological data, we can divide the basin into seven large structural units (Fig. 4), which are, from north to south, the Kucha Downwarp (VII), the North Tarim Uplift (VI), the East Tarim Downwarp (V), the Bachu Uplift (II), the Southwest Downwarp (I), the Tanggubasi Downwarp (IV) and the Southeast Fault Block Uplift (III).

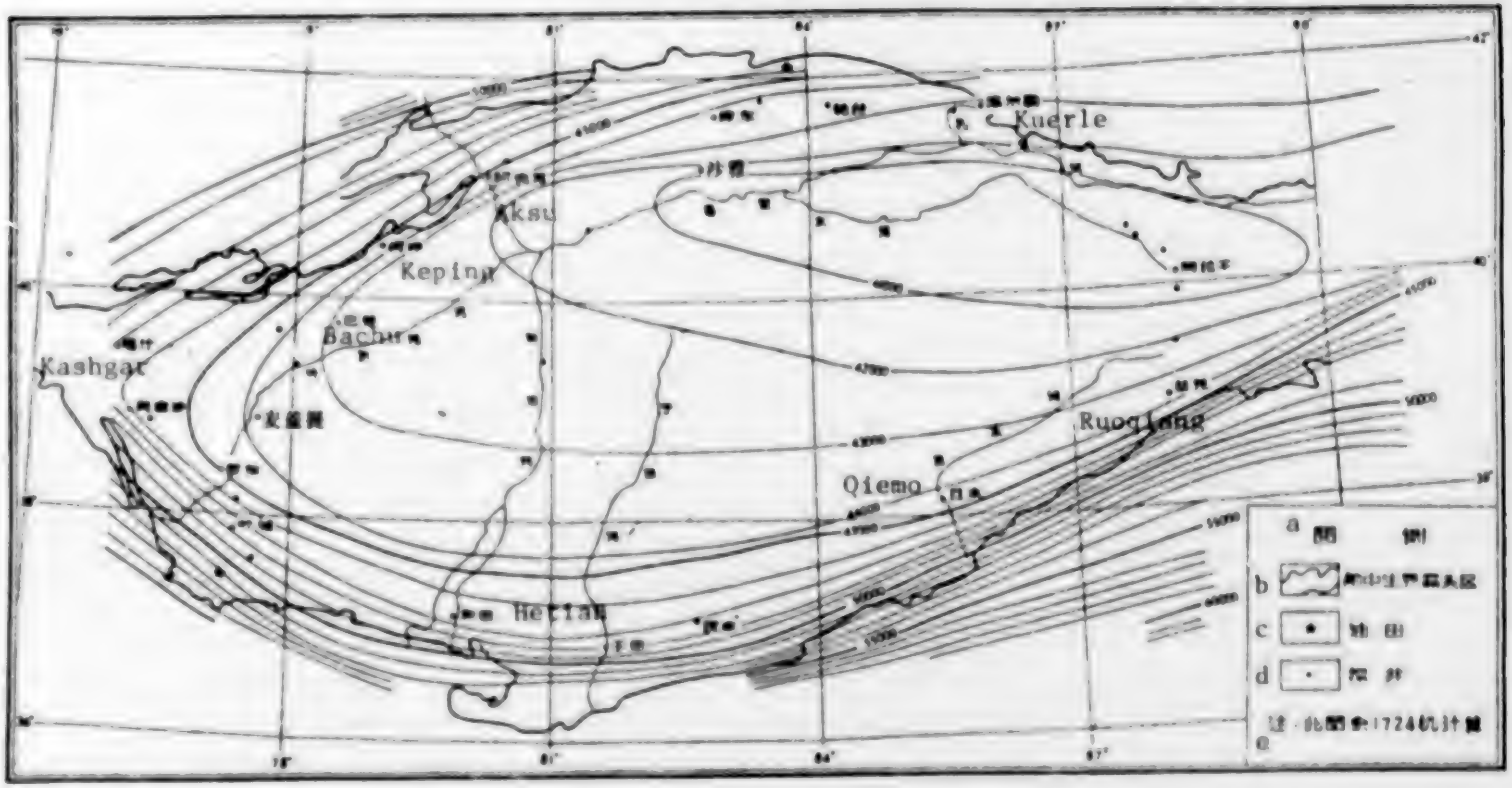

Fig. 3. Density of crust in Tarim plate

Key:
a. Legend
b. Areas of exposure of pre-Mesozoic features
c. Oilfields
d. Exploratory wells
e. Note: Calculations made with 1724 computer

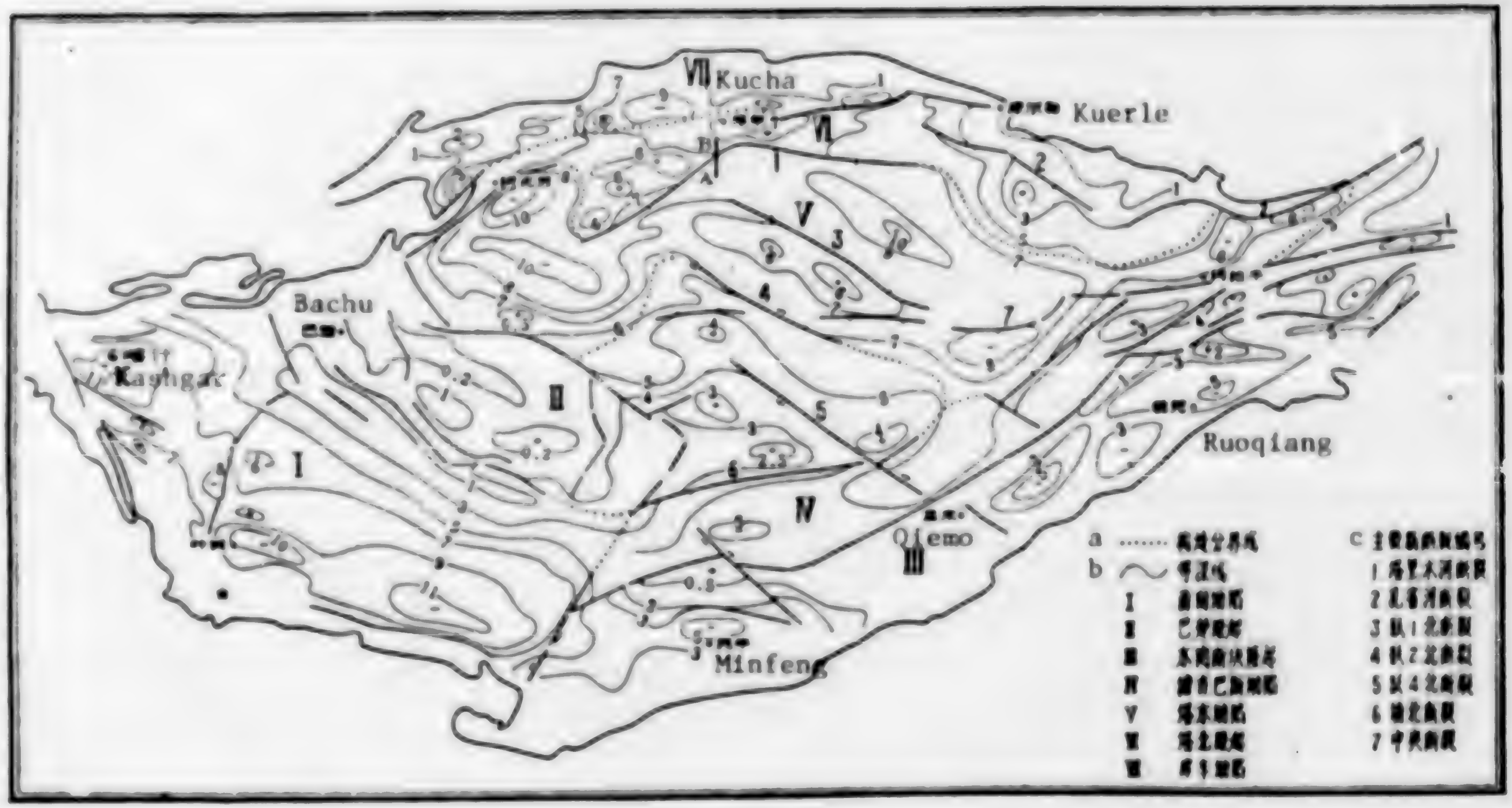

Fig. 4. Structural units and fractures of Tarim plate

Key:
a. Structural boundaries
b. Isobaths
c. Main recent fractures

I. Southwest Downwarp
II. Bachu Uplift
III. Southeast Uplifted Fault Block
IV. Tanggubasi Downwarp
V. EastTarim Downwarp
VI. North Tarim Uplift
VII. Kucha Downwarp

1. Tarim River fracture
2. Kongque River fracture
3. Yue No 1 North fracture
4. Yue No 2 North fracture
5. Yue No 4 North fracture
6. Tangbei fracture
7. Central fracture

A. The Kucha Downwarp. This has an area of about 30,000 square kilometers, and the residual gravitational force shows that the downwarp is divided into three parts from east to west, with the central section being the thickest and the eastern and western sections shallower; it is bounded on the south by the Changmucikedu Fracture and the Luntai fracture, and its Cenozoic and Mesozoic sediments have thicknesses of up to 9,500 meters. The Triassic occurs primarily in the central depression and consists of fault depression sediments. The Jurassic depression extends east and west, with the sediments thinning out toward the south until they disappear; their total thickness is about 3,000 meters. Of these sediments, the middle Triassic, the upper part of the lower Jurassic, and the middle Jurassic are the intervals where oil-bearing strata are concentrated; they consist of melanocratic argillaceous rock about 1,300 meters thick. Because during the Paleozoic period it was in an outer-arc location, the Paleozoic group should be extensively represented. Within the downwarp there are four surface anticlinal structures running side by side from north to south; folding is intense in the northern section, while the terrain becomes more open and rolling toward the south. Seismic data confirm that the deep-lying strata consist of an uplifted fault block; the deep and shallow structures do not correspond, and there are frequent displacement phenomena (Fig. 5). The Iqikelike oilfield and the Tugeerming oil-containing structure have already been discovered in the first of these parallel structures.

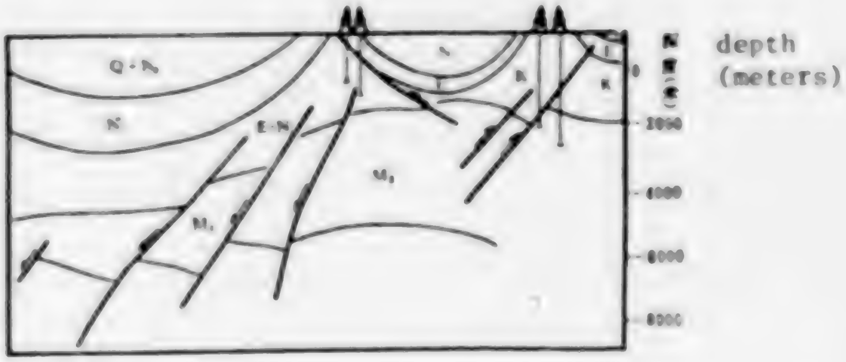

Fig. 5. Displacement of shallow and deep features in Kucha Downwarp (By7903 baseline)

B. The North Tarim Uplift. This runs approximately east and west, and above the second seismic reflecting layer it is a northward-dipping monocline (Fig. 6). The Mesozoic strata pinch out toward the highest part of the uplift, and gravity and magnetic depth calculations indicate that the Paleozoic group is rather thin, measuring about 2,000 meters; this is an uplift area of long standing whose formation was controlled by Proterozoic uplifting.

C. East Tarim Downwarp. This area is about 400 km long and 180 km wide at its widest point, and consists of two deep depressions, east and west. The western part is the Awati depression and the eastern is the Manjia'er depression. The basement rock is at a depth of 10 km and has a "double structure," with a Cenozoic anticline and Paleozoic and Mesozoic depressions (Fig. 6), both of which have depth variations of over 3,500 meters (the section more than 3,000 meters thick below $T_3$ on section 6655 must be Mesozoic, in contrast with the previous treatment of $T_3$ as the top of the Paleozoic group), and the Mesozoic group is over 3,000 meters thick, in addition it is inferred that there should be an upper Permian more than 1,000 meters thick.

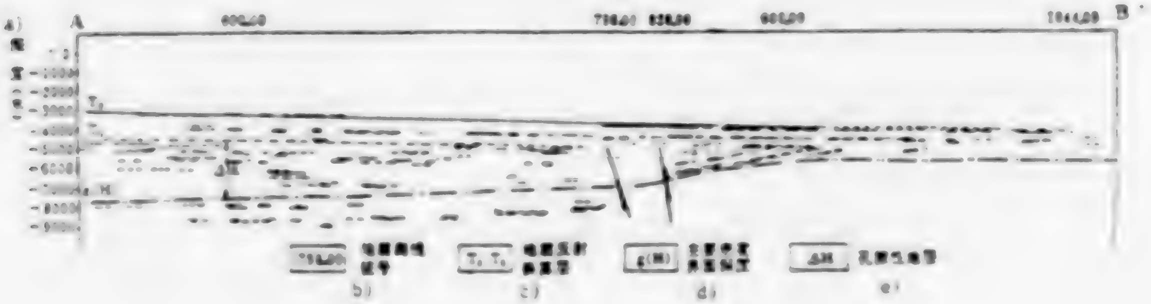

Fig. 6. Seismic reflection density boundaries along baseline 6655.

Key:
a. Seismic baseline markers
b. Seismic reflectivity conversion layers
c. Depth of main density boundary
d. Fissured strata
e. Note: See map for location of section

The Anan No 1 borehole in the eastern part of the depression has no Cretaceous series, and it is thought that there may have been sedimentation in the depression; the Eocene series measures nearly 1,000 meters through, nummulites have been found, and marine facies are present. On the northern margin of the Awati depression near Gancun, Eocene marine facies have been discovered overlying the Paleozoic, so that rocks favorable for the production of oil may have formed in the deepest part of the depression. The Jurassic series, consisting primarily of gray mudstone, is the primary oil-producing stratum. The East Tarim Downwarp is the part of the basin where the crust is thinnest and where sedimentation is most extensive; valleys and ridges alternate, in addition to which there are fractures running toward the northeast and in an east-west direction, forming a prismatic fault block structure oriented primarily toward the northwest.

D. The Bachu Uplift. This is a large uplift running northwest which occupies the central-southern part of the basin. It consists of two sections, eastern and western. In the western section, near Bachu, the Paleozoic group is exposed at the surface, while in the eastern section it is buried at a depth of 4-6 kilometers. The two sections of the Paleozoic group are staggered by a fracture running northeast. In the central rise of the eastern section, the gravitational and magnetic anomalies are everywhere produced by the same features, indicating that the basement rock is rather shallowly buried. The Paleozoic group is rather thin, and it is inferred that the Mesozoic group may be missing and that the Neogene is located at a depth of about 3,000 meters. In the western section near Bachu a complete series from Sinian to Permian is exposed; these remnant strata have a thickness of more than 3,900 meters. The Cenozoic and Tertiary series are quite thin. The upthrust wall of the north-south fault in the uplift is about 1,000 meters thick, while the thickness of the downthrown wall has increased to more than 2,000 meters, indicating that the uplift has persisted since the upper Neogene. The He No 1 well in Bachu passed through a limestone series into the Devonian at a depth of 2,38.5 meters, and the Ba No 3 well did so at 2,845 meters. The limestone series is the main oil formation and accumulation series, consisting of dark limestone 900 meters thick. During the drilling of the well there were large losses of drilling mud; the well produced water and a small quantity of natural gas.

E. The Southwest Downwarp

This rather extensively explored large downwarp consists of a northern slope and a southwestern deep depression, and has an area of 105,000 square kilometers. Its present-day structure is that of a dustpan-shaped piedmont fault depression (Fig. 7).

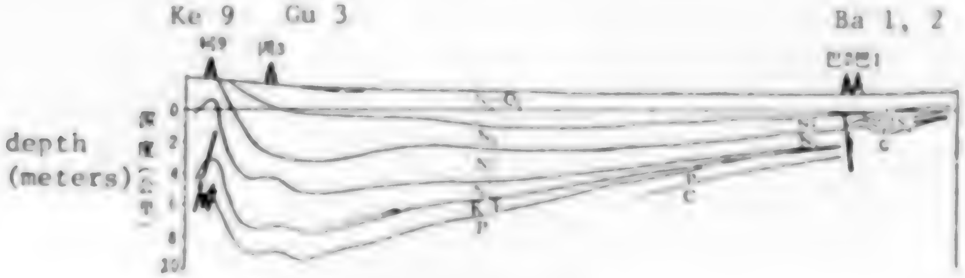

Fig. 7. Kekeya-Bachu 79-320 seismic profile

Centers of subsidence occur at Kashgar, Yechang and Hetian in the piedmont, where the top of the basement rock is more than 10,000 meters deep. At the edge of the Kunlun Mountains there are three rows of surface structures, the southernmost of these, next to the mountains, is intensely folded, while further north they become a rolling anticlinal belt. The Kashgar region is located at the convergence of the Tianshan and Kunlun Mountains and is of complex structure, with three structural groups comprising a total of 35 anticlinal structures. Seismic data confirm that the anticlinal structures are new structures, formed predominantly during the late Tertiary, which slope gently at the deeper levels and are steep at the shallower levels.

Judging by the developmental characteristics of the downwarp, in the Paleozoic it was an outer-arc basin with a sedimentation depth greater than 6,000 meters; the favorable marine-facies series and lower Permian oil-producing rocks are 150-1,400 meters thick. Subsequently, owing to rather intensive uplifting of the northern section, the top Paleozoic layers were stripped away, so that in the Bachu uplift there is an area where the Permian series is missing. Of the Mesozoic group, the Jurassic series forms a piedmont fault depression. The depression is narrow and dissected, and is thickest in the vicinity of Tielieketi, with a total thickness of 3,000 meters, of which dark-colored mudstones account for between 37 and 562 meters, forming a petrographic series favorable for the formation of oil. In the seismic profile, the Cretaceous and Eogene series overlap from the center of the depression northwards, while the scope of sedimentation increases steadily. The cross section shows a characteristic "overlap in the upper sections and denudation below." The deep depression still borders the piedmont area, forming a set of marine series favorable for oil formation. The thicknesses of the oil-forming strata are: $K_2$, 13-103 meters, E, 16-229 meters. In the Kashgar area, the Neogene $N_1$ consists of shallow lacustrine sediments with a thickness of 250 meters. After the Neogene, piedmont sedimentation rapidly becomes thicker, consisting primarily of the 4,000-6,000 meter thick molasse structures which form the previously-mentioned centers of subsidence. The centers of the Mesozoic-Eogene sedimentation depressions moved continuously northward from the piedmont; this process was associated with the gradual uplifting of the Kunlun Mountains. The Kekeya oilfield has been discovered in this area, and extensive oil and gas showing occur from the Carboniferous and Permian through to the Tertiary (Fig. 7).

F. Tangqubasi Depression. It is inferred that this area contains Mesozoic sediments, and it may have been the path by which the sea entered the Tarim area during the Cretaceous and Eogene periods.

G. Southeastern Fault Block Uplift. This is a fault uplift controlled by the Beimin-Qiemo and Aerjin fractures, in addition to which there are small fault depressions in the Cenozoic and Mesozoic groups at Jianggeshayi and elsewhere.

## 4. Long-Term Oil-Gas Prospects

The Tarim Basin was located in an outer-arc position during the Proterozoic, Paleozoic and Mesozoic, so that it is a typical outer-arc foreland basin. To summarize, we have made the findings described below.

A. Because of repeated plate activity, the basin has polycyclic sedimentation characteristics; many sets of oil-producing rock series have been formed. Marine-facies oil-producing strata include the lower Cambrian series, the Carboniferous system, the Permian series, the Cretaceous system and the Eogene system; continental-facies oil-producing strata include the Triassic and Jurassic systems. The marine strata are widespread, while the Triassic system appears only in the Kucha Depression, and other than in the piedmont fault depression sediments to the north and south, the Jurassic occurs rather extensively in the East Tarim area, with a thickness of 3,000 meters or more; it may represent the principal oil-forming stratum in the area.

B. The extent of the structures in the basin is strictly controlled by the Tianshan-Western Kunlun active geosynclinal belts and the Aerjin transform fault. The northern section is a downwarp trending nearly east-west, while the southwestern section is a downwarp trending northwest and the eastern section a fault uplift trending northeast. The East Tarim area is influenced by three structural lines running northwest, northeast and nearly east-west, and there may be a rather large number of structural types.

C. Because during the Cenozoic, the Indian Ocean plate moved rather violently northward and the mountain systems surrounding the basin and old fractures became reactivated, very thick Neogene and Quaternary sediments were deposited in the piedmont areas, increasing the difficulties of borehole prospecting; in addition, because of intense lateral compressive stresses, closely-spaced linear folding has occurred in the surface strata, with evident displacement from deep-lying structures. In the East Tarim area, the Tertiary and Quaternary are relatively thin and structural traps may be relatively numerous; these may be more favorable for oil accumulation than the piedmont areas.

D. The Tarim area is an area of mantle arching and should have a relatively high heat flux value, which is favorable for oil and gas formation.

To summarize the foregoing, we conclude that the East Tarim Downwarp is a more favorable area than the Southwest Downwarp and the Kucha Downwarp. Accordingly, we suggest that in addition to continuing exploration in the latter two areas, the East Tarim Downwarp should be divided up into regions so as to gain an understanding of structural relationships and the distribution of sedimentary rocks, and that suitable areas should be selected for borehole prospecting in order to reveal its secrets.

The Tarim basin has an extensive area, thick sedimentary rocks and many oil-producing strata, so that it offers the material basis for a search for large oil and gas fields. We are confident that such work as regional prospecting, identification of oil-producing depressions, the search for traps and the like will unquestionably lead to new discoveries and breakthroughs.

This article was completed under the guidance of Chief Geological Engineer Wang Shangwen [3769 1424 2429]; Deputy Chief Geological Engineer Yuan Bingheng [5913 4426 3899] read the manuscript. The article makes use of relevant data obtained by the Ministry of Petroleum's Tarim Basin Gravity Interpretation Group and the Xinjiang Province Petroleum Management Office, and we take the occasion to offer our thanks to all concerned.

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## More Surveys Wanted

Hong Kong WEN WEI PO in Chinese 29, 30 Oct 81

[Article by Zhang Yicheng [1728 0110 6134]]

[29 Oct 81 p 7]

[Text] It has been reported that China's confirmed oil reserves are 7 billion tons, with exploitable reserves amounting to 2.3 billion tons, and that 700 million tons have been exploited, leaving only 1.6 billion tons to be exploited. The ratio of exploitation to reserves has decreased from 1 to 60 or 1 to 70 in the beginning to only 1 to 16 today. This situation has caused great concern among those here and abroad who are interested in Chinese affairs. It is natural that people are beginning to ask: What will happen to China's oil production in the future? Where is the Chinese petroleum industry heading?

"A Conference on the Geological and Oil-Gas Resources of Nanhai" has just been held in Guangzhou, with more than 170 experts in oceanographic geology and petroleum geologists coming from all over China. The rich results which have been achieved over the past 20 years or so by China's vast oceanographic geology workers, the overcoming of difficulties and rebirth from one's own power, in matters related to the oceanographic geological survey of Nanhai and the general survey of oil and gas resources are being exhibited centrally at the conference. One of the delegates attending the conference is the famous petroleum geologist, Zhu Xia [2612 1115], who is also an academic committee member of the Chinese Academy of Sciences.

What is the opinion of this petroleum geologist about China's geological work, petroleum production and the petroleum industry in the future? The delegates attending the conference were all eager to hear his learned viewpoint.

On the morning of 24 October, before leaving Guangzhou, Zhu Xia, who was suffering from an illness, delivered an excellent report lasting more than 3 hours before the entire assembly of delegates and geological workers. Although he said his report was "untitled," the report was better without a title than with one. The central theme of his report dealt with the problems of petroleum geological general survey through analysis of the formation process of China's oil and gas bearing basins with the application of modern plate geological theory. The subject was exactly what the representatives wanted to hear and learn about. He opened his remarks tastefully with the words "energy shortage," which had a double meaning. These words referred to the difficulties China is suffering from the shortage of energy and also to his own poor state of health; he had not eaten any breakfast. He first described his background, the "elements" related to being brought up in the "desert" (engaging in petroleum geology work), then began to describe "the directions and routes" (describing a picture of how oil should be exploited in the future).

Zhu Xia graduated from the former Zhongyang University in 1940, and he engaged in work related to the general survey of petroleum geology even before liberation. In the 1950's, he was a regular member of the general survey committee of the Ministry of Geology and participated in drafting the first petroleum survey plan and in compiling, for the first time, "China's oil and gas prospect forecast chart." Later, he participated in person in the geological survey and oil and gas general survey of a number of areas, including the Zhunge-er basin, the Chadamu basin, the Songliao basin and the Huabei basin. Before the great cultural revolutions he served for years as the director of the Petroleum Geology Institute, the Chinese Academy of Geological Sciences, the director of the Geological Institute, and the deputy director of the Oceanographic Geology Institute. After the crushing of the "gang of four," he served as the chief engineer of the Jiangsu oil exploration headquarters and as the director of the Petroleum Geology Institute of the Ministry of Geology. In recent years, he has attended many international conferences on petroleum geology and energy resources. Last year, he presented a paper entitled "On the Structural Evolution of China's Oil and Gas Bearing Basins" at the 26th International Geological Conference held in Paris. His paper was received with enthusiasm and favorable criticism.

This time, Zhu Xia discussed the four M's, the four S's and the three T's concerning petroleum geology and explained how China's oil and gas bearing basins were formed. (The four M's represent the first letter of four English words pertaining to the petroleum geology: material forming petroleum, maturation of the material, movement and maintenance of oil and gas. The four S's represent the first letter of four English words describing the four geological actions controlling the four M's referred to above: settling, sedimentation, stress and style [fengge]. The three T's represent the first letter of three English words: "time," "tectonic position" and "thermal system," which control various types of geological actions.)

Regarding the question of what should be done about China's petroleum industry in the future, Zhu Xia's thesis provided a very good answer by reviewing history and summarizing the experience. In 1949, China's oil production amounted to only

121,000 tons (including 40,000 tons of synthetic oil). In 1955, New China's petroleum general survey work was launched. By 1956, China's oil production exceeded 1 million tons, thanks to the oil found at Lenghu and Kelamayi. In 1965, oil production jumped to more than 10 million tons as a result of the discovery of the Daqing oilfield. Although the growth rate of China's petroleum production was greater than that of other nations, there was also a hidden defect. Its oil reserves did not grow as fast as its oil production. After 1964, while the oil production increased eightfold, the increase in its oil reserves was far from comparable. The ratio of exploitation to reserves dropped from 1 to 60 or 1 to 70 in the beginning to 1 to 16 today, thus creating a situation of grave shortage in reserves. The cause can be traced to excessive emphasis on a higher production index and neglect of general survey and exploration for oil. In foreign countries, the ratio of effort expended on survey and exploration for oil and that expended on oil production is approximately 1 to 1. This ratio is about 1 to 10 in China--that is, 10 parts of the effort go into exploiting the oil while only 1 part of the effort goes into exploring for oil. Why shouldn't the ratio of exploitation to reserves drop sharply when the exploitation is emphasized while the exploration is slighted? Moreover, the petroleum general survey work itself also has shortcomings. The shortcomings consist of "lack of thoroughness in surveying." Only the method of surveying and exploring is emphasized and the geological study and the instructive effect of scientific theory are neglected.

[30 Oct 81 p 7]

[Excerpt] Several Hundred Tectonic Basins Remain To Be Surveyed

What must we do in the future? Zhu Xia believes that a number of measures should be taken simultaneously. While we strive to maintain the present level of oil production, we must also strengthen the general survey and exploration of oil on land and further accelerate exploration and development of offshore oilfields. The general survey and exploration for oil must explore new domains and look for new types. There are altogether several hundred tectonic basins in China, and only a small number of basins have been explored so far. Moreover, in the areas where exploration has been undertaken, the target of exploration has mainly been confined to the stratum of the Cenozoic era. But how about stratum of the Mesozoic era? Or the even older stratum of the Paleozoic era? Oil has been found abroad in the lower stratum of 800-900 million years old belonging to the Paleozoic era. We must attach importance to this fact. Therefore, we must begin to undertake the general survey and exploration of those tectonic basins which have never been explored as soon as possible. And from the very beginning we must pay attention to the various types and various domains and not merely to the stratum of the Cenozoic era. The basins which have been surveyed in the past must be made ready for the second round of general survey. He quoted an anecdote by the famous Chinese American geologist, Prof Xu Jinghua [6079 7231 5479]: A man lost his key and looked for it only in the area lit by a street light. Later, a policeman came to help him find his lost key. The policeman asked him where he lost it, and he replied that he may have lost it in the dark area. When the policeman asked him why he did not look for it there instead of in the lighted area, he replied because this area is lighted! The story has profound significance. Why do we always search for oil in areas where there is a street light and not look for it in the more promising places with the aid of a flash light or even a match? In undertaking the second round of general survey of oil, we must liberate our thinking and not adhere to the traditional forms and customs rigidly. We must summarize the past experience, absorb new theories, and use them as our guide to direct our future work.

Zhu Xia's report made everybody understand clearly that the passive state of affairs experienced by the Chinese petroleum industry today is not due to inferior geological or resource conditions. It was brought about by the mistaken guidelines which directed the work. Within the vast territory of China, on land or in the ocean, favorable geological conditions exist for the formation and accumulation of oil. China's geological workers are up to standard in their ability and are filled with a desire to succeed. In the past, depending mainly on their own efforts, they carried out the general survey and exploration of a large number of oilfields, including Kalamayi, Daqing, Shenli, Dagang, Jianghan, and Subei, and over the years they discovered six great oil and gas fields, including a few in the ocean. They further discovered oil in the Zhujiangkou basin and the Beibuwan basin. Therefore, if we will only adopt the scientific approach and correct our mistaken past practices exemplified by "emphasizing exploitation and slighting exploration" and "lack of thoroughness in exploration," the passive state of affairs characterized by the disproportionate exploitation to reserve ratio can be quickly turned around through the efforts of China's vast petroleum geological workers. And the situation will begin to change with the passage of time and the ratio of 1 to 16 will change to 1 to 17, then to 1 to 18, 1 to 19, up to 1 to 60, 1 to 70, or even higher. The severely disproportionate exploitation to reserves ratio can only drive the Chinese people and the vast petroleum geological workers to correct their past mistaken guidelines and methods, but can never shake their firm belief in China's abundant oil and gas reserves. It can only stimulate them to forge ahead to accelerate the work related to the general survey and exploration for oil and gas but can never extinguish their faith in progress.

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## TA KUNG PAO on Oil Prospects

Hong Kong TA KUNG PAO in Chinese 19 Jan 82 p 1

[Reprint of article in Shanghai SHIJIE JINGJI DAOBAO by Xu Ying [1776 4134]: "The Prospects for China's Oil Development"]

[Text] Looking Ahead

In his report on government work presented at the Fourth Session of the Fifth National People's Congress Premier Zhao Ziyang said that our country's oil production will not decrease year by year. This encouraging conclusion is based on scientific data and won the unanimous praise of all the delegates attending the conference and members of the CPPCC, attending the conference as nonvoting delegates.

Compared with the world's overall crude oil discovery rate the production of oil from underground drilling operations on the mainland such as Daqing is by no means low. During the 1940's the crude oil recovery rate at the Yumen oil field in Gansu Province was 20 percent. By using reinforced water flooding techniques of extraction it would have been possible to achieve a 40 percent rate of recovery.

At present the use of improved reinforced extraction methods has led to the hope that the rate of recovery at the Daqing oil fields will be able to reach a level of 50 percent. Some people try to compare the Renqiu oil field with the major oil fields in Saudia Arabia; in reality the two are really not comparable. While both areas are made up of "structural traps" rich in oil, they have very different types of geological structures and oil deposits, and the differences in the area and thickness of the oil layers are very great. It is important never to announce a victory prematurely.

Worthy of note is that in October 1981 more than a 100 oil experts met in Guangzhou for a symposium on the geology of oil and gas resources in the South China Sea. The discovery of six sedimentary basins containing large gas and oil reserves in the sea area off our country's coastline was discussed at the meeting. Of these areas three are in the South China Sea. They are: the Yinggehai basin, the Northern Taiwan basin and Pearl River estuary basin. These basins all have excellent geological conditions and are extremely rich in oil and gas resources.

Let us take the Pearl River estuary basin as an example. It has an area of 150,000 square kilometres (equal to almost half the area of Guangdong Province) and the prospective reserves of gas and oil exceed those of any single oil field already verified. Severn wells have already been drilled in this area during the past few years and top quality industrial oil flows have already been uncovered by the Pearl River No. 5 well and the Pearl River No. 7 well. They summarized this "story of the stone," making a contribution not only to the enrichment and development of sea-bed expansion theory and plate structure theory but also to the raising of our country's level of scientific research into marine geology.

At a meeting held at the Guangzhou exhibition of offshore engineering the Chairman of the International Energy Agency Mr Fanson, who is an economist, gave an appraisal of our country's oil production. He believes that since China is currently carrying out oil prospecting and exploitation work it will have a very beneficial effect on the medium and relatively long-term future of the world oil market. He gave a comprehensive analysis of China's 13 promising oil-bearing basins, 6 of which have prospects for large-scale commercial production while the other 7 have either no commercial value or limited prospects for small-scale commerical production. Although 2/3 of China's oil-bearing areas are on land, hopes for the future development of China's oil industry rest to a large extent on the opening up of the coastal regions in the east and South China Sea. He estimated that the amount of recoverable reserves is between 15 and 25 billion barrels (7.3 barrels is equal to 1 ton).

In the winter of 1981 the domestic and foreign press began devoting extensive coverage to China's oil production prospects. This is certainly no commonplace occurrence. Thanks to the assistance of Japanese, English, French, American and other foreign countries' oil companies it is estimated that a number of technical problems will soon be resolved. The oil "phoenix" under the rocks has "spread its wings." Abroad it is believed that China has the possibility of doubling its current rate of oil production by the end of the century.

New

The opening up of the Daqing oil field took the "oil-poor" label off China and ended forever the days of China having to use imported oil.

The opening of the Daqing oil field was a great victory won by the Chinese people's spirit of devoting everything to oil. Thousands of oil warriors such as Li Siguang, Weng Wenhao, Huang Jiqing, Xie Jairong and Wang Tieren have marched forward under the guidance of the party and nation towards a victorious future. Of course, the road forward has always been tortuous.

What "information" is there from the sea? First of all one cannot but mention Li Siguang. In 1968 Professor Hoshino wrote a report for the United Nations Asia and Far East Economic Committee outlining prospective oil-bearing regions in the East China Sea. Soon after this the committee announced the joint development of seabed oil in the Yellow, East China and South China Seas. After hearing this news Li Siguang said, "this is not merely a question of who has exploitation rights, it is also a question of plundering natural resources, violating sovereignty and threatening our country's security."

He said, "the question of there being oil resources in the eastern part of the sea was raised by us as early as 1932. While studying in England in 1935 I made implicit references to the 'economically valuable deposits'--meaning oil--in the East China Sea and in North China. The historical facts cannot be disputed."

In 1958 the United Nations convened a meeting in Vienna on the question of continental shelves, drawing up a continental shelf convention and agreeing on an article that made the ocean up to a depth of 200 meters part of the continental shelf and granted natural resources to the country on the coastal mainland. Large shallow sea areas such as our country's Bohai, Yellow, East China and South China Seas and the Taiwan Straits are all part of our country's continental shelf. Li Siguang was at this time stressing the need to develop these coastal oil resources as fast as possible. While the needs of the four modernizations now allow us to consider joint ventures between Chinese and foreigners in the development of seabed oil deposits, our country's sovereign rights remain unquestioned.

During geological explorations 5 years ago there were too many disputes among different schools. Today such controversy seems to be far less acute. Not one of the present generation of geologists is unconcerned with the future of our country's natural resources. When Professor Huang Jiqing went to Switzerland in January 1981 to accept his honorary doctorate from the federal polytechnic he presented an academic report to the institute entitled "A Brief Review of China's Geological Prospecting Work for Oil and Natural Gas." He also revealed an important piece of good "news": China's production of oil will not decrease year by year; in fact, from a general point of view the situation on the mainland is very promising and the prospects for sea oil are excellent.

Our country is very rich in oil resources. In the western parts of our country such as Xinjiang and Qinghai there are vast oil-bearing areas still in need of exploration (in one area this exploration is being carried out with the help of foreigners); this is a task that cannot be completed in the short term.

There is also a possibility of finding small and medium-size oil fields in the eastern section of the interior. There are not only "structural traps" but also "outcrops," and if we concentrate our energies we should be able to see results within 3 to 5 years. The exploitation of oil, including Daqing, needs both electricity and transport facilities.

Professor Li Chunyan, 77 years old, said, "my time left for work is limited as no one can ever dodge the laws of nature; I just hope that in my remaining years I shall be able to do a few more years' work in the area of geological surveys." The lofty ambitions of the older generation have not yet aged. What a fine example this is!

Contrast

Well-known international petrochemical companies have appeared one after another in China. French, Japanese, English and American companies are all trying to overtake each other in friendly emulation.

In 1978 there were already nine American oil companies hoping to sign oil prospecting agreements with our country. Standard Oil of California and Texaco were the first oil companies to arrive, followed by EXXON, Mobil and City Service. They all wanted a share of the "treasure."

The head of the Natural Resources Committee Sun Yueqi, who was once the economics minister for the nationalist government and is now nearly 80 years old, recalled the history of oil development in China, contrasting present and past conditions. He was personally involved in three phases of this development. During the last years of the Qing Emperor Guang Xu, Japanese technicians were invited to prospect for oil around Yanchang in northern Shaanxi. After this the American oil company Mobil began drilling in the area and during the early period of the war of resistance against Japan he acted as head of the North Shaanxi Oil Prospecting Department. This is a low-yield oil field and exploration work is continuing to be carried out in the surrounding area. Sun Yueqi was also the general manager of the Yumen Oil Field in Gansu Province. At that time only evaporation-type refining furnaces could be used and the amount of petroleum refined was only 10-odd percent, with the annual rate of production being around 2 million gallons. In 1943 he went to Xinjiang to help in the running of the joint Sino-Soviet oil fields at Dushanzi. At the time it was also reckoned that the Chaidamu basin had oil "outcrops." Despite this knowledge, however, the country's weakness prevented any development. He said, sighing with emotion, "since the founding of New China there has been considerable development in oil investigation work. Geological exploration work has been carried out by scientists, technicians and workers in the sedimentary basins of northeastern, northern and eastern China.

Thanks to the use of drilling rigs to open wells we have been able to find oil fields such as Daqing, Shengli, Dagang and others. The prospects for oil extraction from the sea are also very promising at present. Having witnessed the rise and fall of three oil fields in the old China I am filled with excitement and happiness."

Discussing the contrast between past and present, Sun Yueqi also commented that, "oil extraction from the sea is a burgeoning industry in our country. Faced with this developing industry we lack both experience and capital; therefore, it is correct to invite tenders, and to make full use of foreign capital and technology." He also commented that, "as I understand it the Taiwan China Oil Company has a certain amount of strength in the field of seabed oil exploration. Either the Ministry of Petroleum Industry or the National Resources Committee should perhaps extend an invitation to Taiwan, welcoming them to submit tenders. In the future, oil could be supplied directly to Taiwan on the basis of shares.

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## South China Sea Survey

Guangzhou GUANGZHOU RIBAO in Chinese 25 Oct 81 p 1

[Article: "Major Developments in Comprehensive Survey of South China Sea"]

[Text] Another new development has been achieved in the comprehensive geological-geophysical survey of the South China Sea jointly conducted by Chinese and American scientists who have basically determined the origin and formation age of the South China Sea, thus enabling them to learn further more about the features and resources of the South China Sea.

The joint survey is conducted by China's South China Sea Geological Survey Headquarters and the Lamont-Doherty Geological Survey Institute of Columbia University who have performed 116 days of offshore operations since the end of last year. All the projects in the survey mission were successfully completed, and all kinds of geological and geophysical data were gathered systematically. Subsequently, the scientists of both countries analyzed and processed the survey data in New York, thus gaining new understanding of the many geological problems which had been found in the South China Sea.

How was the South China Sea formed? How old is it? In the past, no unanimous conclusion could be drawn. Through the current survey, the scientists proved that the South China Sea had originated from sea floor expansion, and the formation age was approximately 32-17 million years ago, which, in geological terms, was in the Oligocene to Miocene Epochs. Through multichannel seismic surveys of the deep sea basin covering about 2,000 kilometers, plus surveys with 17 sonar buoy stations, the maximum thickness of the sedimentary formation was found to reach as much as 3,000 meters, whereas the crustal thickness varied from approximately 5 to 8 kilometers.

The joint surveys helped the scientists to get a better understanding of the South China Sea, especially the distribution pattern of mineral resources in the northern part of the sea. For instance, in terms of regional tectonic pattern, it was discovered that the structure could be pyroclastic and lenticular; it is quite possible that the structure contains large deposits of oil and gas. In the northwestern portion of the basin, 'bright dots' appeared in the seismic profile, which could very well indicate the existence of natural gas. In addition, through careful study of digital seismic data covering almost 10,000 kilometers of the Pearl River Mouth Basin, it was found that the maximum thickness of the sedimentary formation in that area was some 8,000 meters; this discovery has enabled us to learn more about the prospects of the oil reserves in the Pearl River Mouth Basin.

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CSO: 4006/133

## Briefs

GANSU PETROLEUM OUTPUT--By the end of October, the (Dayaohe) oilfield under the Yumen Petroleum Administration, had produced 21,100 tons of crude oil, overfulfilling the annual plan by 11.2 percent. This is a record output for the oilfield. Exploration of the oilfield officially began in 1959. It entered an advanced stage of development in 1975. Some 30 oil wells have been sunk on the oilfield, of which 28 have been put into operation. [Lanzhou Gansu Provincial Service in Mandarin 1125 GMT 7 Dec 81 SK]

GUANGDONG PETROLEUM PROSPECTING BASE--The South China Branch Company of the China Petroleum Company has built an initial offshore petroleum exploration and development base in Zhanjiang. Plans for petroleum exploration and development work in the South China Sea were prepared as early as 1973. Over the past 8 years, through the efforts of some 8,000 technical cadres and workers, geophysical prospecting and drilling work has been carried out on land and sea from Xizmen, Fujian in the east to Beibu Bay, Guangxi in the west, a distance of some 9,000 kilometers, and achieved various results. [Guangzhou Guangdong Provincial Service in Mandarin 1000 GMT 12 Nov 81 HK]

OIL PROSPECTING IN HEBEI--It has been learned from the Hebei Oil Control Bureau that by the end of September the following new results were achieved as a result of a petroleum geological survey and exploration carried out in Hebei: Confirmed oil-bearing areas have been expanded by more than 30 square kilometers through exploration of the sandstone of the tertiary system over an area coving Hejian, Suning, Xiong County and Ba County. Three oil-bearing hidden mountains were found through exploration of the limestone layer, and a few wells are already producing industrial oil at high yield. A breakthrough has been made in the peripheral area with a certain well in the newly explored area in the north with industrial oil flow. The areas in which oil exploration was carried out have been expanded and the prospect is very bright. [Article by Wang Xinghong [3769 5281 1347] [Text] [Shijiazhuang HEBEI RIBAO in Chinese 24 Oct 81 p 1] 9113

HEILONGJIANG PETROLEUM OUTPUT--The Daqing Petroleum Administration, in Heilongjiang Province, prefulfilled by 2 days its annual petroleum production plan of producing 51.5 million tons of crude oil. This is 51.5 percent of the nation's total output. This is the sixth successive year that the Daqing oilfield has produced more than 50 million tons of crude oil. [Harbin Heilongjiang Provincial Service in Mandarin 2200 GMT 29 Dec 81 SK]

SHANDONG CRUDE OIL OUTPUT--Shengli oilfield, Shandong Province, has prefulfilled the 1981 crude oil production plan. It is expected that by the end of 1981, this oilfield will overfulfill the annual crude oil production plan by 205,000 tons. [Jinan Shandong Provincial Service in Mandarin 2300 GMT 27 Dec 81 SK]

NEW XINJIANG OIL PIPELINE--The Xinjiang parallel pipeline from the Kelamayi oil field to Urumqi has been put into operation. The total length of the pipeline is more than 290 kilometers. On 1 November, oil started to flow from the first station in Kelamayi and reached the last station in Urumqi on 8 November without a hitch. The first pipeline from the Kelamayi oil field to Urumqi was constructed some 10 years ago. [Text] [Beijing Zhongguo Xinwenshe Domestic Service in Chinese 0828 GMT 17 Nov 81 HK]

CSO: 4006/162

DAQING USES NATURAL GAS--Daqing, 28 Dec (XINHUA)--Daqing oilfield in northeast China, which opened in 1960 has developed technology for on-site utilization of natural gas, according to the Daqing Natural Gas Company. The oilfield, which produces 2,500 million cubic meters of natural gas a year, uses more than 60 percent of the yield, the company said. Cold weather, low underground pressure and water content in the oilfield are Daqing's major problems in gas accumulation and transport. Their research to date has been into pressure increase, dehydration, protection of pipes from frost, recovery of volatile gas in large tanks and extraction of light hydrocarbons. Facilities for accumulation and transport of natural gas, including booster stations, gas filling stations, gas storage tanks and pipes, have been installed. [Text] [Beijing XINHUA in English 0701 GMT 28 Dec 81]

CSO: 4020/68

NEW GEOLOGICAL FINDS--Beijing, 20 Dec (XINHUA)--Chinese geologists have found more than 110 new mineral deposits and made surveys to enlarge the reserves of more than 130 old mining areas this year. They have fulfilled or overfulfilled the 1981 targets for finding new reserves of 29 minerals listed in the state plan. New areas with oil resources have been discovered, and progress has been made in the prospecting for new coal deposits. A lignite field covering 100 square kilometers in Nei Monggol has an estimated reserve of 2,000 million tons, and the Yongcheng coalfield in Henan Province has a proven reserve of 1,200 million tons. Nonferrous metal mineral beds were found in 13 new places and nonmetallic ores in 29 new places. The prospective reserves of more than 50 mines have been enlarged. [Text] [Beijing XINHUA in English 1204 GMT 20 Dec 81 OW]

CSO: 4006/224

## HYDRO-POWER CONSTRUCTION, PROJECTS EXPANDING

### Installed Capacity Discussed

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 9, 12 Sep 81 pp 5-11

[Article by the Planning Department of the Chengdu Surveying and Design Institute of the Ministry of Electric Power Industry: "Several Opinions Concerning the Selection of Installed Capacity of Large and Medium Hydroelectric Power Stations"]

> [Text] Editor's note: To summarize the experience in the selection of installed capacity of hydroelectric power stations during the 30 years since the founding of our nation, the Chengdu Surveying and Design Academy was commissioned by the Hydroelectric Power Construction Bureau to carry out field surveys in the northeast, the northwest, the eastern and south-central regions. At the same time, concerned units also summarized the experience in this problem. This article has been written on the basis of the survey, research and summaries. After completion of the first draft, it was presented for discussion at a discussion meeting on the selection of installed capacity of hydroelectric power stations held in Chengdu, and it was revised on the basis of the views put forward in the discussion. We believe that through this summary, there will be new improvements and developments in the theory and practice of selecting installed capacity of hydroelectric power stations in our nation.

Since the founding of the nation, our nation's hydropower workers have realized achievements in the theory and practice of selecting the installed capacity of hydroelectric power stations and have accumulated experience. The installed capacity of most hydroelectric power stations has been proven by inspection of actual operation to be appropriate and basically adapted to the development of the national economy of each region. But because of the relatively long period of interference by "leftist" ideology, disrespect for science, not doing things according to economic rules, and failure to make technical and economic comparison, some of the installed capacity of hydroelectric power stations is not suitable, causing unwarranted loss to the state. As the national economy has developed, the number of hydroelectric power stations going into operation has continued to increase, and the scope of the power supply has continued to expand, creating more and more limiting factors for the selection of installed capacity, so it is necessary to summarize some basic problems. These problems include problems in understanding, technical problems and problems of policy. Some views and opinions regarding the following problems are presented:

## 1. There Must Be Unified Understanding of the Three Links in Design

During the course of design, the three main links--design standards, basic data and computational method--must be clearly understood from beginning to end before the installed capacity can be accurately selected. In the past, during the course of design of some hydroelectric power stations, the installed capacity varied greatly, there were reversals and many changes, and after completion, the stations could not develop the function they should have had, or they could not reach the designed requirements, and the main reasons were that these three links were not tightly grasped and the objective, actual situation was not taken into account.

The correct installed capacity of a power station should not depend on subjective wishes but should be limited by objective rules and tested by practice. From the standpoint of objective economic rules, a rational installed capacity requires the expenditure of a specific amount of capital to realize the best economic result. Therefore, the installed capacity of hydroelectric power stations should be selected in the spirit of respecting science and respecting the actual situation, by taking mainly technical and economic comparison as the standard, by combining regional characteristics and by carrying out overall analysis and proof. But in the past, during the period of "leftist" ideological interference, the purely economic standpoint in the design concept was mistakenly criticized and obedience to "political needs" was emphasized, leading to a situation of blind commands, letting subjective will "provide the beat." This lesson must be profoundly remembered.

The basic data in selecting the installed capacity mainly include natural runoff and planning for rivers and involve the future scope of power supply, load characteristics, composition of the power source system. Problems exist in the gathering and compilation of basic data. Especially in planning for rivers and planning for the power system, because of insufficient emphasis over a long period, and with the many changes in policy, difficulties in the work were created artificially, affecting the reliability of the basic data. For example, the estimated indexes of the load level of the system were too high, some even reaching an incredible degree. Some plans for rivers were extremely rough; designs for a certain power station were carried out even before plans for the rivers existed. Construction was hasty, and as a result, the combination of the power stations and the load of the system did not coincide with the actual situation, and the construction could not be adapted to the needs of the power system. We believe that the treatment of basic data should not be like abandoning eating because one has choked; we must admit that difficulties and deficiencies exist objectively, and in the future we must approach the actual situation in a conscientious and responsible spirit. Concerned leading departments must fully emphasize plans for rivers and plans for the power system, and take practical measures to strengthen this work for each link of the system, to strengthen agencies and standards. Experience has proven again and again that only by using correct plans that have been approved by the higher authorities as a basis can the design of power stations be reliable and the installed capacity be accurately selected.

regarding the problems of computational methods, at present our nation still uses the methods of the 1950's. These methods produce a more accurate result in designing hydroelectric power stations with a power network of a relatively small scale and with a relatively simple structure in the power source. But as the system continues to expand, as the relationship among the various aspects of power supply characteristics, composition of power sources, comprehensive utilization of hydroenergy and energy replenishment and stepped development become more complex, it is difficult to use the past means of computation to accurately realize the design principles. For this, we should actively organize forces, strengthen theoretical research in kinetics, apply computational means of present-day systems engineering theory and electronic computation techniques to develop research in optimizing the selection of the design of installed capacity in a big way so that the computational method of optimum selection of the installed capacity can be further perfected as quickly as possible.

## II. The Current Design Principles Are Basically Feasible

Our nation's selection of installed capacity of hydroelectric power stations generally undergoes the following process: The amount of water and power of hydroelectric power stations (as a group) are balanced on the basis of plans for the rivers and plans for the power system. Next, the electric power and the amount of electricity of the electric power system are balanced according to the need of the load, and then the installed capacity is selected after technical and economic comparison. The basic content of this kind of design principles, generally speaking, is "balancing two aspects and comparing one aspect." We know that the operational process of hydroelectric power stations (as a group) is the process of balancing the amount of water and the power obtained from the corresponding waterhead (i.e., amount of electricity and guaranteed output), or the process of balancing the amount of water and power. Then, through measures of generation, transmission and transformation based on the characteristics of the power station, and according to the working capacity of the system and the arrangement of the reserve capacity to carry the peak or the basic load of the system together with other power stations, we can insure the needs of the users of electric power, i.e., a process of balancing electric power and the amount of electricity. Actually, these two processes are carried out simultaneously. The design principles of the installed capacity constitute an analysis carried out on the basis of these two balancing processes. In essence, they are an analysis of the process of balancing the energy of the hydroelectric power station and its economic results. They are also a true reflection of the actual operating process. This is the core of the design principles. Practice shows that these design principles are feasible. For example, during the 1950's, inspection of the actual operation of the Gutianxi first-level hydroelectric power station and the Yilihe Step Hydroelectric Power Station, which were designed according to these principles, revealed that their working capacity and reserve capacity in the system, their work posts in the system and on the load graph all coincide closely with the designed expectations, and that the installed capacity was appropriate.

We consider that using the annual number of hours of utilization to select the installed capacity of hydroelectric power stations is unsuitable. The number of hours of utilization of installed capacity is only one of the indexes that reflect the relationship between the annual amount of electricity and the installed capacity.

Actually, the installed capacity of the hydroelectric power station is determined after technical and economic proof following analysis of such factors as the load of the system, the structure of the power source, the natural characteristics of the hydroelectric power station and engineering characteristics. It can be seen that the annual number of hours of utilization is not a basis for proof but the result of proof. The number of hours of utilization is different in different regions, nor is it necessarily the same for power stations of different properties within the same region; the installed capacity will change as the situation in the system changes when the startup time of the same power station differs. It can thus be seen that using the annual number of hours of utilization as the criteria for the selection of installed capacity is inappropriate. But for hydroelectric power stations with similar conditions within the same region when the composition of the system does not change greatly, the annual number of hours of utilization of installed capacity should generally be within a range of variation. After analyzing the characteristics of energy resources of the region and the trend of development, it is still feasible to use the annual number of hours of utilization for a rough estimate for future planning of installed capacity.

Obviously, the function of using the annual number of hours of utilization to measure the installed capacity of a hydroelectric power station is not comprehensive, because it does not reflect the problem of the quality of power supply of the hydroelectric power station and the gain of the capacity involved in guaranteed output. The superior performance of peak regulation, frequency modulation and reserve capacity for emergencies of hydroelectric power stations is far beyond the capabilities of thermal power stations. Therefore, the number of hours of utilization of the installed capacity of hydroelectric power stations is frequently lower than that of thermal power stations (except for runoff type hydroelectric power stations). Thus, if one concludes that 1 kilowatt of installed capacity of a hydroelectric power station cannot be fully utilized as 1 kilowatt, obviously it is a misunderstanding of the function of the hydroelectric power station in the system. We can consider establishing a statistical index for the coefficient of utilization of the capacity and combine it with the current annual number of hours of utilization (equivalent to the coefficient of the amount of utilization of electricity) in the overall analysis and evaluation of the degree of utilization of the installed capacity of the system or the power station during actual operation.

## III. The Key To Balancing Electric Power and the Amount of Electricity is Reliability of Planning

The balance of electric power and the amount of electricity is an important link in selecting the installed capacity. It is the basis for planning the system and planning for the rivers. These plans reflect a comprehensive balance in the national economy of the region 10 to 20 years in the future, and they influence many aspects. We must combine the balance of electric power and the amount of electricity with the characteristics of the power station to analyze the plans, to measure the reliability of the balance of electric power and the amount of electricity, and to correctly select the installed capacity. The load of the system, the arrangement of the power source and the system network are very closely related to the design of the power station.

1. Reexamination and summarization of the data on some power stations show that the installed capacity of peak regulating hydroelectric power stations is affected more by the load characteristics of the system and correspondingly less by the size of the load. For example, the working capacity of the Liujiaxia Hydroelectric Power Station when the maximum loads are 1.6 million and 2 million kilowatts is 490,000 and 510,000 kilowatts, respectively, when the load characteristics do not change, a difference of only 4 percent. The Xinanjiang Hydroelectric Power Station once used the 1962 system load (daily load [factor] of 0.86) as the basis and calculated the maximum load for 1967 on the basis of a growth rate of 8-15 percent to be 1.22-1.65 million kilowatts and a corresponding working capacity of 350,000 - 410,000 kilowatts, a difference of about 18 percent. This means that when the annual load changes in multiples, the scale of change of the working capacity remains limited. If we check the actual load in 1972, which approaches the designed load, when the daily load [factor] is respectively 0.845 and 0.881, the difference in working capacity is 10 percent. Also for example, in the Beijing-Tianjin-Tangshan system, which has few hydroenergy resources, to solve the problem of peak regulation, emphasis was placed on analyzing the peaking process over only a period of 3 hours. It can be seen that special attention must be paid to the analysis of load characteristics. But it should be pointed out that reexamination of the design of many power stations shows that estimates of the rapid increase in the agricultural load has been insufficient, and this has affected in varying degrees an accurate analysis of the installed capacity.

2. In planning the power source, the last hydroelectric power station to be built during the year in designing the level of installed capacity will be included in the balancing of electric power and the amount of electricity, and it will affect the installed capacity of the designed hydroelectric power station. For example, during the design of the Xinfengjiang Hydroelectric Power Station, a lot of work in kinetic analysis was carried out, but the status of a 323,000-kilowatt hydroelectric power station waiting to be built was not clear; the peak of the system in the original consideration was to be handled by the Xinfengjiang and Liuxihe Power Stations, but actually the continuous entry into operation of many other hydroelectric power stations caused the capacity of the Sinfengjiang Power Station to be slightly larger than expected, and the overlapping capacity of the system increased, so the fourth generator was set aside as a reserve generator. Again for example, the Jiangxi Zhelin Hydroelectric Power Station underestimated the situation of the Wanan Hydroelectric Power Station that may possibly start production in the near future but the construction has been postponed again and again, and it did not arrive at the correct conclusion of reserving beforehand one or two generators. It can be seen that closely related power sources greatly affect the scale of installed capacity of the power station being designed, and detailed surveys and analysis must be carried out to the extent possible.

3. The system network (scope of power supply and tidal distribution) also can seriously affect the development of the function of the installed capacity of a hydroelectric power station. For example, in 1974, the Kunming area seriously lacked electric power, and because the third and fourth step loop lines of the steps at Yilihe had not been formed, there was a delay in commissioning 80,000 kilowatts of electricity, constituting one-fourth of the total capacity. The changes resulting from the start of network operation of the Danjiangkou Hydroelectric Power Station explain this point more fully. The power station is the

largest hydroelectric power source in the power systems of the two provinces of Henan and Hebei. For a long time in the past, it operated at a low water level, using separate generators for separate systems. It was only in 1979 that the method of joint network operation of the original design was finally realized, and thus, the gains in the various aspects of system operation, transportation of coal, storing water in the reservoir and comprehensive utilization were realized on an overall basis. In the design, we must carefully analyze the weak links in the network and the tidal distribution, consider the mutual relationship among the power stations, envisage the various situations in which a network might possibly emerge, and carry out a balancing of the whole network and a balancing in the separate regions. A correct range of power supply and a suitable network distribution are very important in fully developing the gain of the power station. It is very difficult to imagine that separating the design for the hydroelectric power station and the design for the system could enable the operation of the system to achieve expected results. For a long time now, mutual coordination between the planning of the network and design of the hydroelectric power station has been insufficient. In the future, work in this respect should be greatly strengthened. The close coordination of the design of the power station and the design of the system in the general setup also urgently needs improvement.

The plans, designs and the actual situation of some of the hydroelectric power stations built during the "1950's" were better coordinated. This was because at the time, the power source of the system was relatively simple and the political situation was stable; the national economy could develop according to plan; and it was possible for planning work to approximate the actual situation more closely to serve as a reliable basis for the accurate selection of installed capacity.

## IV. Calculation of the Energy Indexes Should Approximate the Real Situation

The function of the installed capacity of a hydroelectric power station is first of all to have guaranteed energy. The two important indexes of guaranteed output and annual amount of electricity directly affect the selection of the installed capacity, which is manifested in the design and tested in practice. The records of operation over many years show that the energy indexes of most of the hydroelectric power stations in our nation have not reached the designed requirements. Table 1 gives some incomplete analytical statistics showing the deficient annual output of electricity of several hydroelectric power stations.

We can understand some commonly existing problems from these limited statistical data.

1. In the past, almost all hydroelectric power stations operated for a long period at a lower water level. This was not the result of incomplete design. For a long period, many power stations deviated from the regulations governing electrical power transfer and operation: "power was generated whenever there was water, and electric power was limited when there was no water," forcing some power stations to shut down their generators for long periods, and the system was damaged.

Table 1. Itemized Statistical Table of the Average Annual Loss of Electricity of Several Hydroelectric Power Stations

| 1) 项目 |  | 2) 电站 3) 石泉 | 4) 刘家峡 | 5) 古田一级 | 6) 以礼河梯级 | 7) 映秀湾 | 8) 长湖 |
|---|---|---|---|---|---|---|---|
| 9) 损失电量占实发电量的百分数(%) | 来水量偏小 10) |  |  | ✓② | ✓ | ✓ |  |
|  | 水库低水位运行 11) | 2.8 |  | ✓ | ✓ |  |  |
|  | 电厂尾水位抬高 12) | 1.8 | 4.15 |  | ✓④ |  |  |
|  | 机组设备影响 13) | 1.6 | 2.23 | ✓ | ✓④ | ✓ |  |
|  | 水头损失偏大 14) |  |  |  | ✓④ | ✓ |  |
|  | 调度不当 15) |  | 4.1 | ✓③ |  |  |  |
|  | 施工影响 16) |  |  |  | ✓ |  |  |
|  | 输电线路不全 17) |  |  |  | ✓ |  |  |
|  | 水量设计不同 18) |  | 19.5 |  |  |  |  |
| 19) 统计期实发年平均电量(亿度) |  | 4.83 | 45.23 | 2.59 | 11.64 | 6.6 | 3.04 |
| 20) 统计期设计多年平均电量(亿度) |  | 5.12 | 55.94 |  |  |  |  |
| 21) 统计期实发年平均电量/统计期设计年电量(%) |  | 94.2 | 80.3 |  |  |  |  |
| 22) 设计多年平均发电量(亿度) |  | 6.3 | 56.8 | 3.47 | 16.0 | 7.6 | 3.0 |
| 23) 统计期实发年平均电量/设计多年平均发电量(%) |  | 76.6 | 79.6 | 74.5 | 72.7 | 87.0 | 101.4 |
| 24) 统计期年平均流量(米³/秒) |  | 265.0 | 885 | 43.7 | 15.65 | 335 | 173 |
| 25) 设计多年平均流量(米³/秒) |  | 341.5 | 830 | 49.8 | 18.92 | 352 | 164 |
| 26) 统计期年平均流量/设计多年平均流量(%) |  | 77.8 | 106.7 | 87.7 | 82.6 | 88.0 | 105.4 |
| 27) 统计期年份 |  | 75～79 | 76～80 | 60～73 | 71～79 | 74～78 | 75～79 |
| 28) 全部机组开始投入年份 |  | 75 | 73 | 60 | 71 | 72 | 74 |

29) 注：①石泉、刘家峡统计期设计年电量系按实际来水计算；②"✓"表示具有该项因素，系定性分析；③古田一级部分弃水系因系统负荷过低的缘故；④仅以礼河梯级第三级的情况；⑤长湖电站缺分项原因分析。

Key:
1. Item
2. Power Station
3. Shiquan
4. Liujiaxia
5. Gutian First Step
6. Yilihe Step Stations
7. Yingxiuwan
8. Changhu
9. Amount of loss of electricity as a percentage of actual amount of electricity generated (%)
10. Less amount of incoming water
11. Operation at a low water level in the reservoir
12. Rising of tailwater of the power plant

13. Effects of generator equipment
14. Large loss of waterhead
15. Poor regulation and transfer of power
16. Effects of construction
17. Incomplete transmission power lines
18. Incomplete design of hydroenergy
19. Annual average amount of electricity actually generated (100 million kilowatt-hours) during the statistical period
20. Designed average amount of electricity over many years (100 million kilowatt-hours) during the statistical period
21. Annual average amount of electricity actually generated during the statistical period/designed annual amount of electricity during the statistical period (%)
22. Designed average amount of electricity over many years (100 million kilowatts)
23. Annual average amount of electricity actually generated during the statistical period/designed average amount of electricity generated over many years (%)
24. Average annual flow during the statistical period (cubic meters/second)
25. Designed average flow over many years (cubic meters/second)
26. Average annual flow during the statistical period/designed average flow over many years (%)
27. Years of statistics
28. Year in which all generators began production
29. Note: 1) The designed annual amount of electricity during the statistical period of Shiquan and Liujiaxia are calculated according to the actual amount of incoming water; 2) "  " indicates that such a factor exists, it is a qualitative analysis; 3) a portion of the water at the Gutian First Step Power Station was abandoned because the load of the system was too low, 4) this refers to the situation at the third step in the Yilihe step stations; 5) the Changhu Power Station lacked an itemized causal analysis.

The results of tests of the Zhexi and Danjiangkou Hydroelectric Power Stations operating according to the actual amount of incoming water during the same period and according to the designed power transfer charts showed that on this basis not only can the power stations insure a normal supply of electric power, but they can also produce more electricity and greater comprehensive gain can be realized. These facts show that the guaranteed output of a hydroelectric power station is not an index that can be abolished but a very important reference for normal operation of the system. The system must strongly emphasize the great significance and the limiting conditions of guaranteed output. Happily, during the past year or two, many power stations have begun to operate normally and have realized definite achievements.

2. The annual average runoff of many power stations is relatively dry. According to statistics, over the past 15 years, the annual average amount of incoming water at 46 large and medium hydroelectric power stations on 32 rivers constituted 90 percent of the designed annual average amount of incoming water. This is one of the reasons that the actual annual output of electricity at many power stations is lower than the designed value. Whether this nationwide drought condition belongs to a climatic cycle remains to be investigated. Some power stations produce less because comprehensive utilization of water on the upper reaches has increased or because the hydrological series is too short. These problems require strict analysis of hydrological data, and more attention should be paid to the investigation of historical records of drought for power stations that have regulated power for many years.

3. In the design of hydroenergy, there are generally two situations that cause the designed amount of generation of electricity to be slightly high:

The first situation mainly pertains to external objective causes, such as the use of an overly low tailwater level for the power plant, an overly small loss of the waterhead, and an overly large efficiency for the hydraulic turbine, etc. Because of irrational construction and piling up of broken bits of material, the actual tailwater level of power plants is elevated. For example, the tailwater level of the Gongzu Hydroelectric Power Station is elevated about 2 meters, and the loss in electricity is 7.7 percent of the actual amount of electricity generated. The tailwater level of the Liujiaxia Hydroelectric Power Station is elevated some 3 to 4 meters, and the loss of electricity is about 4.2 percent of the actual amount of electricity generated. A smaller calculated loss of the waterhead is mostly reflected in the diversion type hydroelectric power station, such as the Yuzixi First Step Power Station and the Yilihe Third Step Power Station. In addition, because of defects in the equipment, the efficiency used in the design for many generators was slightly high, for example, the actual efficiency of the Gonzu Power Station was lower by 2 percent. After performing efficiency tests on the generators at Zhexi, the efficiency of the generators was also lower than the efficiency converted by computation from the model.

Because of inappropriate fitting of generators or unilaterally pursuing large single generator capacity, the original designed waterheads of many power stations were slightly higher, increasing the capacity for congestion of the generators, lengthening the period of congestion, and reducing the amount of electricity generated. For example, the period of congestion of the generators of the Yunfeng and Fengman Hydroelectric Power Stations reached 50 to 60 percent. The designed waterhead of the Gongzu Power Station as reflected in both the original design and the present situation is too high. Because of the fitting of the generators, the elevation of the tailwater on the lower reaches and similar factors, the waterhead during the flooding period was not sufficient and output was blocked for as long as 4 months. It was very difficult for the Hengren, Bailianhe, Songtao Power Stations to operate at full capacity because the designed waterhead was too close to the maximum waterhead value. An overly high designed waterhead is the most commonly existing problem at present; frequently, the operating water level of the reservoir is too low, and when the consumption of electric power suddenly increases for irrigation, the capacity of the power station becomes seriously congested, greatly reducing the gain the power station should have, and the installed capacity does not live up to its stated capacity. In the past, due to neglect of the economic gain of long-term operation of a power station, and to the influence of the factors mentioned above, we have paid a very high price, and it is hoped that the concerned sectors will cooperate with us very closely in devoting attention to this problem.

The second situation mainly pertains to subjective causes, i.e., in the past, balancing of electric power was emphasized, while balancing of the quantity of electricity was neglected. When calculating the annual amount of electricity, the limitations of the system in accepting the amount of electricity from the designed power station were not considered, or the balancing of electric power and the quantity of electricity was not linked to the balancing of the actual power and amount of electricity of the system. For example, the Northwest Surveying and Design Institute reexamined the annual amount of electricity of the Liujiaxia Hydroelectric Power Station and showed that after all the installed generators entered production, the average amount of electricity actually generated from 1976 to 1980 was 4.523 billion kilowatt-hours and the system could accept only 4.71 billion kilowatt-hours of electricity. But during the corresponding statistical period, the designed annual quantity of electricity reached 5.594 billion kilowatt-hours, surpassing the quantity of electricity the system could accept by 15.8 percent. In the summary of statistics on the Shiquan Hydroelectric Power Station, the contrast between the computed results of the designed operating condition and actual operation showed that the designed operating conditions were suitable, but that the deficiency of 6.2 percent in the quantity of electricity was mainly due to such objective causes as the operating water level and equipment. For this power station, the difference in the computed amount of electricity due to causes in design is great. It can be seen that in a system with a weak network and a complex power source structure, special attention must be paid to the difference between the amount of electricity the power station can generate and the amount of electricity that can be accepted by the system. Detailed investigation must be carried out in balancing the power and the amount of electricity of the designed power station. Only by calculating the annual amount of electricity on this basis can it coincide with the actual situation. In addition, the amount of annual generation used as a basis for calculating economic gain without taking into consideration the loss of electricity in long-distance transmission and transformation is inappropriate. The amount of electricity a hydroelectric power station can generate and the amount of electricity that can be sold by the system are also different. All these matters need to be improved.

## V. The Design Level Should Be Dynamic

The design level is an important prerequisite for determining the necessary capacity. If it is set too high, it may cause the peak regulating capacity of the designed power station to become too large because of the increase in the load of the power system. Conversely, the peak regulating capacity may be too small. In the past, the standards have always followed the use of a fixed level year as the basis for design. In the 1950's, we mainly referred to Soviet regulations and procedures, i.e., using "the fifth year after the capacity of all the generators had begun operation" as the main design level year. Later, this was changed to using "generally the fifth year after the first generator began operation" as the main design level year. In 1977, the dynamic design regulations stipulated that "generally the fifth to the tenth year after the first generator began operation could be used". None of the numbers of years stipulated in these standards have a convincing basis.

The situation of several hydroelectric power stations of more than 100,000 kilowatts already built in our nation is illustrated in Table 2.

Table 2.

| 1) 水电站名称 | 2) 柘林 | 3) 刘家峡 | 4) 丹江口 | 5) 新丰江 | 6) 龚嘴 | 7) 七里垄 | 8) 柘溪 | 9) 新安江 |
|---|---|---|---|---|---|---|---|---|
| 10) 第一台机投入年月 | 72.8 | 69.4 | 68.10 | 60.8 | 71.12 | 68.12 | 62.1 | 60.4 |
| 11) 必需容量投入年月 | — | 73.7 | — | 66.4 | — | — | 72.1 | — |
| 12) 全部机组投入年月 | 75.6 | 73.7 | 73.9 | 66.4 | 78.12 | 76.12 | 75.6 | 78.12 |
| 13) 装机总年数 | 3 | 4.5 | 5 | 5.5 | 7 | 8 | 13.5 | 18.5 |

Key:
1. Name of hydroelectric power station
2. Zhelin
3. Liujiaxia
4. Danjiangkou
5. Xinfengjiang
6. Gongjie
7. Qililong
8. Zhexi
9. Xinanjiang
10. Year and month when the first generator began operation
11. Year and month when the necessary capacity was produced
12. Year and month when all generators began operation
13. Total number of years of installation

It can be seen from Table 2 that the time between the startup of the first generator to the startup of all generators generally varies within a range of 5 to 10 years, but there are some less than 5 years (Zhelin) and longer than 10 years (Zhexi and Xinanjiang). The year of realization of the final scale varies for different power stations; this is an objectively existing fact. Therefore, a simple stipulation of a fixed design level year has greater flexibility. We consider that each plan, when conditions allow, should take the design level as a dynamic parameter and in principle it should balance the power and the amount of electricity for each year; this means that during the years before all the gain is developed, it is more appropriate to calculate the amount of electricity and the gain in capacity for each year on the basis of balancing the power and the amount of electricity of the system, and to carry out economic discussion and proof.

## VI. When Selecting the Installed Capacity in Regions With Less Hydroelectric Power, Analysis of the Function of the Installed Capacity Should Be Emphasized

Our nation's northern, eastern and northeastern regions all have few hydroenergy resources and little hydroelectric power. The situation of three systems in 1979 (see Table 3) showed: the working capacity of the existing hydroelectric power stations cannot satisfy the demands of peak regulation for each system, and some hydroelectric power stations actually have even a smaller capacity for peak regulation because of the limitations imposed upon them by comprehensive utilization (such as the Guanting and Miyun Power Stations in northern China and the Meishan and Foziling Power Stations in eastern China). As the system developed, the difference between the peak and the trough increased, and such conflicts appeared even more outstanding. Most of the peak regulating tasks in these regions must rely on thermal power stations for realization, and this bring about many problems for the system: The quality of power supply of the system will be affected, the cycles and the stability of the voltage of the system cannot be guaranteed. The peak regulating generators are turned on and off frequently, the parameters are unstable, the equipment is easily damaged, inspection and repairs have to be increased. The generator furnace and equipment need heat for reserve use and cannot operate frequently in the high efficiency range; the loss of steam and heat increases, consumption of coal increases, and in particular, the consumption of fuel oil for igniting drastically increases, causing the index of economic gain of the thermal power plant to drop.

Compared to the thermal power plant, the hydroelectric power station is characterized by fast startup and versatile operation, suitable for carrying out peak regulation, frequency modulation and other reserve tasks of the system. It can reduce the burden of the thermal power plants in the system, conserve coal, and improve operating gain. The hydroelectric power stations requires generally only a few minutes from startup to full load. This outstanding function shows hydroelectric power stations can carry more emergency reserve capacity in the system to improve the safety and reliability of operation of the electric power network.

Table 1.

| Power System | Beijing Tianjin Tangshan | Eastern China (Shanghai, Jiangsu, Zhejiang, Anhui) | Northern China |
|---|---|---|---|
| Maximum load (10,000 kilowatts) | 354.5 | 581 | 602 |
| Difference between peak and trought of load (10,000 kilowatts) | 90 - 96 | 133 | 162 |
| Peak load as a percentage of maximum load (%) | 25 - 27 | 23 | 27 |
| Total installed capacity of hydroelectric power (10,000 kilowatts) | 21 | 145.8 | 153 |

It is very difficult for any electric power system to avoid sudden emergencies or the unplanned rise and fall of loads. Hydroelectric power stations as a means of solving emergencies are very helpful in insuring a safe power supply by the system. For example, an emergency in the Beijing-Tianjin-Tangshan system suddenly occurred in January 1961. The Miyun Hydroelectric Power Station, which had not been generating any electricity, was temporarily utilized: it had to generate electricity for 1 hour to maintain output balance, and it basically insured the stability of the cycles of the electric power network. The Shuifeng Hydroelectric Power Station in the northeastern system was shut down completely in September 1971, losing a load of 330,000 kilowatts; the cycles of the system dropped from 50 to 48.6 hertz. The Fengman Power Station juxtaposed two generators within 6 minutes and increased output by 140,000 kilowatts, preventing a further spread of the emergency. Also, on 1 January 1978, two 300,000-kilowatt generators of the Wangting Thermal Power Plant in the northeastern system malfunctioned simultaneously, and coincidentally the Wujing Power Plant and the Huaibei Power Plant also malfunctioned; the cycles of the system suddenly dropped to 47 hertz; the low cycles reduced the load and jumped the gates, drawing 60,000 kilowatts in emergency; at this time, the Xinanjiang Hydroelectric Power Station was able to take up the burden in time, changing danger to safety for the system. Similar situations are countless. Therefore, when considering the installed capacity in regions where the proportion of hydroelectric power is small, besides carrying out the normal tasks of peak regulation, frequency modulation and reserve during inspection and repairs, we must start out from the requirement for safe operation of the system to appropriately increase the special function of serving as a reserve during an emergency in the system to strive toward fully developing its capacity functions. This point has not been sufficiently considered in past design.

In the north, the east and the northeast, because the best hydroenergy resources are being developed one after the other, as future load develops, the proportion of hydroelectricity will become smaller and smaller, and the demand for hydroelectric peak regulation and reserve by the system will increase day by day. To more fully and rationally utilize the limited hydropower resources, we should consider the problems of investment accumulation and construction; we should seriously study the problem of providing reserve generators beforehand. Some hydroelectric power stations abroad have been expanded again and again, and the experience and lesson of tearing them down and rebuilding them is worth our attention.

## VI. Selection of the Installed Capacity in Regions With a Larger Proportion of Hydroelectric Power Must Consider Both the Balance of Capacity and the Balance of the Amount of Electricity

In the joint hydroelectric and thermal power systems which have a larger proportion of hydroelectricity, such as our nation's southwest and northwest regions, the selection of installed capacity must emphasize analysis of the distribution of capacity among the hydroelectric power stations, and at the same time, it must pay attention to the utilization of the amount of electricity during the flooding period to accurately estimate the economic gain of the installed capacity.

1. In balancing electric power related to distribution of capacity, the function of power stations already built must first be fully developed. The succeeding power source beginning operation before or after the designed power station and the designed level year presents a problem of optimal distribution of capacity and electricity. The regulatory function, the geographic position, the dynamic economic characteristics of the succeeding power source will all affect the distribution. Of these, special attention must be paid to the difference in regulatory properties. Take the design of the Ertan Hydroelectric Power Station in Sichuan as an example: if the succeeding power source is either a runoff power station or a daily regulatory hydroelectric power station, the working capacity of the Ertan Power Station would correspondingly be either 2,290,000 or 1,960,000 kilowatts, a difference of 330,000 kilowatts. If it is a hydroelectric power station serving replenishing and regulatory functions over many years, the Ertan Power Station can establish a fixed overlapping capacity. It can be seen that the succeeding power source greatly influences the installed capacity of the designed power station. Therefore, in the design, the power stations of the system must be considered as a whole to carry out a rational distribution of the installed capacity (and the order of installation); we must not continue to study the installed capacity of the designed power station in isolation.

2. In the utilization of electricity, considering the principle of overlapping capacity on the basis of satisfying the necessary capacity is suitable for a rational utilization of hydroenergy resources. The type of hydroelectric power station in the rear of a dam which has a poor regulatory function usually establishes a definite overlapping capacity in order to conserve coal resources and to enable it to ease a power shortage over the system, and under specific conditions, such a power station can also be converted to necessary capacity, especially in regions deficient in hydroenergy resources.

Seasonal acceptance of electric power by a system usually is carried out in these forms: Hydroelectric power can replace thermal power so that thermal power generation can be lessened or even shut down to conserve coal. Seasonal users can be established. Large reservoirs can also be built to improve the hydroelectric regulatory function of the system, to convert seasonal electric power into necessary electric power or to expand the scope of power supply for long-distance transmission of electricity so that electric power can be fully utilized.

Establishing seasonal users is a strong measure for utilizing seasonal electric power. Our nation's energy sources are insufficient, but the northwest and southwest regions have rich hydroenergy resources. How to rationally utilize them is an important subject. Take Sichuan, for example: the reserves of hydroenergy resources constitute 22 percent of those of the whole nation. The resources that can be exploited amount to a per capita average of only 0.92 kilowatt; this is not rich. There are very few reservoirs within the region with a superior regulatory function; the utilization of nearly 10 billion kilowatt hours of seasonal electric power is an existing problem. The establishment of seasonal users still lacks mature experience in the nation. For example, in 1979, the Emei Iron Alloy Plant in Sichuan had already utilized the seasonal electric power of the Gongzui Hydroelectric Power Station according to plan for 8 months. This is a good start. The state's planning departments and electric power departments should also concretely solve the new problems of the quality of power supply, price of electricity and new problems brought about by seasonal production of the users for the utilization of seasonal electric power while considering long-distance transmission of electricity. It would obviously be inappropriate for us not to open up wide roads for seasonal electric power, create the proper conditions, and develop the superiority of hydroenergy resources, but simply to limit hydroelectric installations and take a passive balancing attitude.

Practice shows that utilization of hydroenergy is a task with strategic significance in the construction of hydroelectric power. The selection of the installed capacity is a key problem in the utilization of hydroenergy. Inappropriate selection of installed capacity makes it difficult for the hydroelectric power station to realize the gain it should have. There are many reasons that influence the selection of installed capacity. For a long period, the designed conditions did not undergo many changes, so planning data taken as important design prerequisites are not able to adapt to the needs of design. To improve the level of design through only the efforts of hydroenergy designers is far from enough; it is suggested that the leadership at each level emphasize this work, unify understanding, and take effective measures regarding each link in the work related to the system: policy, theoretical research and first-phase planning. Only in this way can the expected results be realized.

9296
CSO: 4006/163

## Construction in Northeast

Beijing DILI ZHISHI [GEOGRAPHICAL KNOWLEDGE] in Chinese No 10, 1981 pp 3-4, 16

[Article by Chen Shangkui [7115 0006 1145]: "Hydropower Construction in the Three Northeast Provinces of China"]

[Text] The Three Northeast Provinces constitute one of China's most highly developed industrial areas where petroleum output accounts over one half of the whole country's oil production, and steel, cars, chemical industry, nonferrous metals and power equipment hold an extremely important position. Moreover, Heilong- jiang Province is a major base for our country's forestry industry and commodity grain production. Electric power is indispensible to the development of industry, and steel, chemical industry, petroleum, and nonferrous metals are great power consumers. For example, last year, steel, chemical industry and petroleum alone accounted for 35 percent of the whole year's power output. Thus, the growth of power industry plays a decisive role.

### Exploitable Water Resources

Electric energy is a renewable energy source transformed from such non-renewable energy sources as coal, petroleum, hydraulic power, nuclear energy, natural gas, etc. The development of the power industry must have non-renewable energy sources as the basis. A thermal power plant of 1 million kilowatts capacity consumes 3.6 million tons of coal to generate 6 billion watts of electricity per annum. According to surveys by concerned departments, the geological reserves of coal resources in the Northeast Region is approximately 50 billion tons (including the three leagues [meng] in the eastern part of Nei Mongol Autonomous Region), but the distribution is very uneven. The coal resources are chiefly found in Heilongjiang Province and Nei Mongol's Hulun Buir League and Jiren League which account for more than four- fifths of the overall reserves; the development conditions are rather unfavorable, and the coal quality is comparatively poor. In the Northeast, China's largest oil- field Daqing produces more than 50 million tons of oil per year. But China's energy policy does not permit the use of petroleum as fuel for generating elec- tricity. Owing to the irrational development of power plants which burn oil fuel in the early 1970's, almost 20 million tons of oil fuel were consumed by power plants throughout the whole country last year, which accounted for one-fifth of the nation's total oil output. As far as power generation is concerned, the North- east was one of the greatest oil fuel consumers, and last year it consumed 6.19 million tons. In the future, steps will be taken not only to stop construction of new oil fuel power plants, but also to hasten the remodelling of existing oil fuel power plants; the conservation of petroleum will be brought about as soon as possible by substituting coal for oil.

Hydraulic power resources are one of the major energy sources for developing the power industry in Northeast China. According to the 1980 general survey of water power resources throughout the whole country, the potential hydraulic power resources of all the rivers in the Northeast (including part of Nei Mongol) amount is over 13 million kilowatts[1], and can generate up to 130 billion watts of electricity annually, which is 2.4 times the amount of electricity generated last year in this part of the country; approximately 80 million tons of coal can be saved each year by tapping such water resources. There are 140 rivers with drainage areas of more than 1,000 square kilometers which can support 463 hydropower stations with installed capacities of over 500 kilowatts, and their combined installed capacity amounts to more than 13 million kilowatts; among them, there are 140 hydropower stations of over 10,000 kilowatts in generating capacity and 12.7 million kilowatts of installed capacity. Heilong Jiang, Songhua Jiang, Yalu Jiang, Di'er [Second] Songhua Jiang, Mudan Jiang and Nen Jiang are rivers of fairly high potentiality. Heilong Jiang is the border river between China and the Soviet Union; its total length measures over 4,470 kilometers, the mainstream measures 3,478 kilometers; the entire drainage area can support 20 hydropower stations which can generate over 10,000 kilowatts, and their combined installed capacity is 4.36 million kilowatts. The Di'er Songhua Jiang stems from Tianchi in the Changbai Mountain; its total length is 803 kilometers; the drainage area is 74,345 square kilometers. Rainfall is abundant in the upper reaches of the river where the annual mean precipitation ranges from 800 to 1,000 mm. The annual mean flow at the river mouth is nearly 510 seconds cubic meters. The topographic relief is high in the southeast and low in the northwest. The drop is concentrated; the entire river's drop is 1,556 meters. Altogether, the mainstream and 18 tributaries can provide 56 hydropower stations with installed capacities of more than 3.3 million kilowatts; the conditions for exploitation are fairly good and the stations are quite close to the load center of the users. This river is a treasure house of Northeast China's hydraulic resources. Mudan Jiang measures 705 kilometers in total length; the drop is 806 meters; the entire drainage area measures 37,055 square kilometers and 22 hydropower stations with combined installed capacity of 1.07 million kilowatts can be built in the river basin. Nen Jiang is the main tributary of Songhua Jiang, flows through the northwestern portion of Heilongjiang Province, and joins with the Di'er Songhua Jiang at Sancha River Mouth in Fuyu Xian; its total length is 1,108 kilometers, its drainage area is over 220,000 square kilometers and 14 large/medium power stations with installed capacities of 1.887 million kilowatts can be set up here. The Yalu Jiang is another key river which originates from Tianchi in Changbai Mountain, and is the border river between China and Korea. Its entire length measures 800 kilometers; the drainage area is over 60,000 square kilometers, each country sharing approximately one half. Most of Yalu Jiang's mainstream flows through mountains; along its banks are numerous high mountains; its total drop is up to over 2,400 meters; it has rich hydraulic power resources, and can support power stations with combined installed capacity of 2.37 million kilowatts. With the exception of Heilong Jiang, the rich water power resources are all not far from heavy power consuming cities and industrial/mining areas. The Northeast is spacious but thinly populated; the hydropower station and reservoir areas have had relatively few cases of flooding damage; most of the power stations are of medium scale, not much engineering is required, the degree of difficulty in development is minimal; but quick results can be obtained. Thus, the maximum use of hydraulic energy resources is an important way of developing Northeast China's hydropower industry.

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[1] The international river hydraulic resources apply only within Chinese territory; the mainstreams of border rivers are computed at one half.

Newly Built and Enlarged Hydropower Stations

From the time China was liberated to the end of 1980, the Northeast Region has altogether built ten large and medium scale hydropower stations in Fengman, Shuifeng, Yunfeng, Jingbohu, Huanren, Huilongshan, Taipingshao, Baishanfeng, Shenwo and Xiaoqiaoshan; their combined installed capacity is 1.84 million kilowatts, which accounts for 18 percent of the combined installed capacity of hydro and thermal power stations in the Northeast Region. As hydropower generators can be quickly turned on and off, it takes only a few minutes to set a generating unit into operational mode. These hydropower stations serve primarily as backups for peak adjustments, frequency adjustments². More than one half of the peak adjustment operations are carried out by hydropower plants, which is extremely important to the stable, safe and economical operation of the power grid.

The hydropower construction in the Northeast Region began in 1937 when the Japanese imperialist built the Shuifeng Power Stations along the Yalu Jiang and Fengman Power Station along the Di'er Songhua Jiang in order to plunder the resources of Northeast China and Korea. The two power stations had their first generating units installed in 1941 and 1943 respectively. In 1942, the Jingbohu Power Station was built along the Mudan Jiang. Following the surrender of the Japanese imperialist, these power stations were seriously wrecked; some generating units were dismantled and taken away. After the liberation of the whole country, tremendous efforts were made by the People's Government to restore and remodel the Fengman Hydropower Station, and it was completed in 1954. The Fengman Power Station is located in Jilin Province's Jilin City. The Di'er Songhua Jiang is cut in the middle by a concrete gravity dam measuring 90 meters high and 1,080 meters long, thus forming the famous Songhua Lake, a huge artificial lake which has the capacity to hold 10.8 billion cubic meters of water. The hydropower station has 9 water turbine generating units with total capacity of 554,000 kilowatts and annual mean power generation of 1.89 billion watts, which is equivalent to 44 percent of the generated power throughout the entire country in 1949. This power plant is directly controlled by the Northeast Power Central Bureau, and is currently the main hydropower plant of Northeast China's power network. It plays the most vital role in backing up the power grid's peak adjustments, frequency adjustments and breakdowns. Moreover, it offers a number of economic benefits, such as flood prevention and irrigation, i.e., it can help protect 1.21 million mu of cultivated land from flood disasters, irrigate 1.18 million mu of farmland, and provide the cities and industries in the lower reaches of the river with water supply. Located in Liaoning Province's Kuandian Xian, the Shuifeng Power Station was restored in 1955, and it is jointly controlled by China and Korea, each country sharing one half of its current total installed capacity of 630,000 kilowatts. The Jingbohu Power Station is situated in Heilongjiang Province's Ning'an Xian. Jingbo Hu [Lake] is a natural dammed lake which had formed in the Quaternary Period due to river blocked by extrusive basalt rock-flowage. It has a waterfall of over 20 meters in height. The natural lake is utilized by the power station, i.e., a huge reservoir which can hold 1.6 billion cubic meters of water was formed by constructing a giant dam measuring

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[2] Peak adjustment is using hydropower stations to generate additional electricity whenever the power grid reaches peak consumption level in the course of the day. Frequency adjustment is to maintain the 50 cycle period in the power grid.

2,534 meters long and 6 meters high; and a 3,000 meters long tunnel was excavated to tunnel the water to the power generators. The original installed capacity was 36,000 kilowatts; after liberation, the station was restored and enlarged, and the current installed capacity is 96,000 kilowatts. It is the only large-scale hydropower station of its kind in the eastern portion of Northeast China's power grid (Jixi, Jiamusi, Madan Jiang, Yanji), and its main role consists of power and peak adjustments.

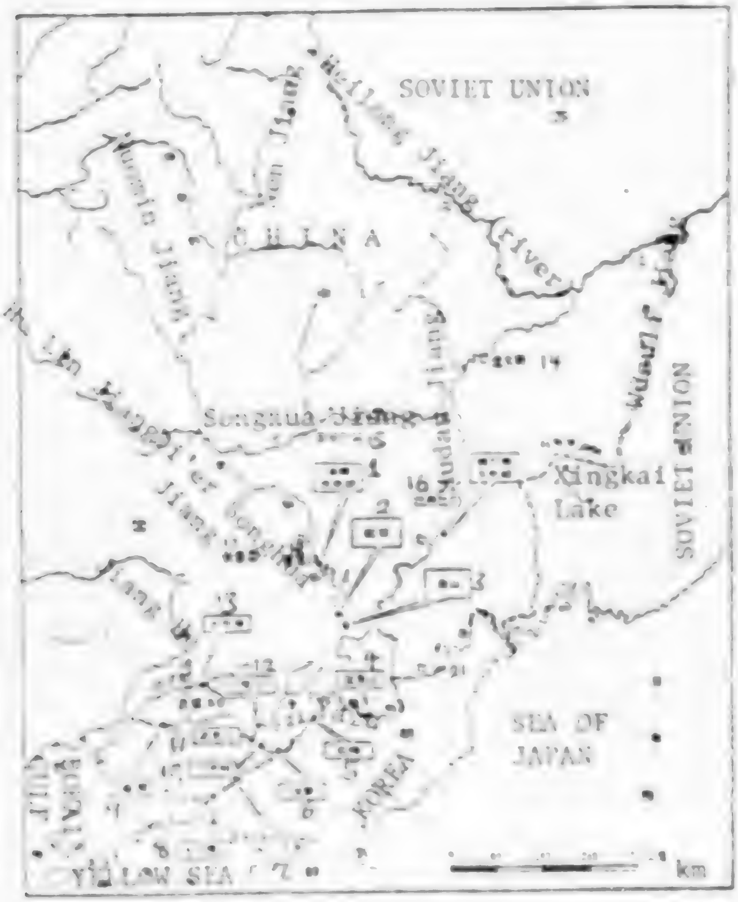
After liberation, besides restoring and enlarging the preceding power stations, seven new large-medium-scale hydropower stations were built in the Northeast, e.g., Huanren, Taipingshao, etc. Huanren, Huilongshan and Taipingshao constitute a group of step power stations along the Hun Jiang which is a major tributary of the Yalu Jiang. The Huanren Power Station is the first level. Located northeast of Huanren Xian, it has an installed capacity of 222,500 kilowatts, a huge reservoir that can hold 3.45 billion cubic meters of water is used for annual adjustments, which is not only adequate for this power station, but also for two more power stations in the lower reaches of the river. Thus, a single body of water can provide multiple services. The Huilongshan Power Station is the second level. It is situated south of Huanren Xian, has 7 [illegible] kilowatts of installed capacity, and a water reservoir of 120 million cubic [illegible] which can only do daily adjustments. The Taipingshao Power Station is located [illegible]theast of Kuandian Xian, a 200 million cubic meters reservoir is used for daily adjustments; the installed capacity is 160,000 kilowatts. It is a hydropower station that was built in a relatively short period of time in recent years; the construction began in 1975 and the station was completed last year. The three power stations are close to Anshan and Shenyang Cities which are chief power consuming areas in Northeast China's power grid; high voltage power lines of 220,000 volts are directly linked to these cities; the power stations play an important role in the power grid's peak adjustments as well as ensuring the power supply of An'gang, etc. Dahuofang and Shenwo Power Stations were built along Liaoning Province's Hun He and Taizi He respectively. The Dahuofang Power Station is 20 kilometers from Fushun, its reservoir can hold 2 billion cubic meters of water; besides serving the power generators, it is used mainly for supplying water to Fushun and Shenyang, and can irrigate over 1.2 million mu of farmland. The Shenwo Power Station is 35 kilometers from Liaoyang; its reservoir can hold 800 million cubic meters of water, its installed capacity is 37,200 kilowatts. Besides generating power, it also provides Liaoyang City and other places in the lower reaches of the river with protection against floods. Jointly built in the 1960's by China and Korea along the mainstream of Yalu Jiang, the Yunfeng Power Station is a large-scale power station situated in Jilin Province's Ji'an Xian. Construction began in 1959; the first generating unit began operating in 1965, and the entire station was completed in 1967. The reservoir's storage capacity is 3.9 billion cubic meters, and can make multi-year adjustments. The installed capacity is 400,000 kilowatts; the annual generating capacity is 1.75 billion watts, each country sharing one half. The [illegible] Power Station is located in Jilin Province's Changbai Xian. It was built along the [illegible] Gou, which is a tributary on the upper reaches of Yalu Jiang. It is a medium-size power station with installed capacity of 18,000 kilowatts.

## Energetically Develop Water Resources

At present, the Northeast China power grid is merely second to the East China power grid, and it is the second largest power grid throughout the whole country. The combined installed capacity of the Three Provinces [in Northeast China] is approximately 100 million kilowatts; the annual generated power is 54 billion kilowatt hours, which includes 48.9 billion kw/hrs of thermal power and 5.1 billion kw/hrs of hydropower. But the power industry is still a weak link in the Northeast Region. Owing to power shortage, many factories can not operate to the fullest capacity. The construction of more thermal power stations is limited by the fuel problem. In 1980, 3.29 million tons of coal for power stations were shipped to the area from Shanxi and Ningxia, which not only increased the cost of power generation, but also incurred tremendous difficulties in transportation due to bottlenecked rail lines. To solve the power shortage problem in Northeast China, efforts must be made to restrict the development of power consuming industries and increase the proportion of light and textile industries while energetically developing Northeast China's power industry and building new power plants at the same time. Besides speeding up the exploitation of the local coal resources in the Northeast, it is also imperative to energetically develop Northeast China's water power resources and accelerate the construction of hydropower stations.

At present, six hydropower stations are under construction, e.g., Baishan, Weiyuan, Taipingwan, Hongshi, etc. Their installed capacity is more than 1.4 million kilowatts. The Baishan Power Station will be the largest hydropower station in the Northeast. It is located inside Jilin Province's Huadian Xian, which is upstream from the Fengman Power Station in the upper reaches of Songhua Jiang in the Changbai Mountain Valley Region. The power station has a concrete gravity dam measuring 146 meters in height and 663 meters in length. Three 300,000-kilowatt generating units will be installed, with an installed capacity of 900,000 kilowatts. It is possible that the station will be expanded to 1.5 million kilowatts. The construction work began in 1975; the river was dammed in 1979, and the main dam is currently under construction. The first unit is expected to start generating power in 1983. The Hongshi Power Station is also located in Jilin Province's Huadian Xian; it is being built on the Di'er Songhua Jiang between the Baishan and Fengman Power Stations. Its water reservoir is linked to the tail water of the Baishan Power Station. Its projected installed capacity is 200,000 kilowatts. It is one of the major power station engineering projects that has gotten underway this year. The Weiyuan Power Station and Taipingwan Power Stations are large/medium size hydropower stations jointly built along the mainstream of Yalu Jiang by China and Korea. Weiyuan Station's projected installed capacity is 390,000 kilowatts, Taipingwan Station's projected installed capacity is 190,000 kilowatts. Both power stations will be jointly owned by the two countries, each country sharing one half of the generated power.

Besides speeding up the construction of the preceding hydropower stations to make use of them as soon as possible, it is also necessary to build new hydropower stations energetically. At present, the development of Northeast China's hydraulic resources is mainly concentrated in the southeast area along the Yalu Jiang and Di'er Songhua Jiang. Very little development is being done in other areas. With the exception of the Heilong Jiang mainstream which cannot be developed due to the Sino-Soviet relations problem, there are quite a few spots along the lower reaches of Mudan Jiang and Nen Jiang which are suitable for building large and medium power plants. For example, Buxi of the Morin Dawa Banner, which is located along the Nen Jiang mainstream; Lianhuapao of Hailin Xian, which is along on the Mudan Jiang mainstream; and Changjiangtun of Yilan Xian--these places are all suitable for large scale hydropower stations of 250,000 to 500,000 kilowatts. Large numbers of medium hydropower stations can also be built along these rivers. In view of our country's financial and material resources, positive steps should be taken to develop in a planned and systematic way all those water resources which offer fairly good conditions for exploitation, so that they can serve the Four Modernizations program of Northeast China.



Hydropower Stations:

1. Fengman Hydropower Stations
2. Hongshi
3. Baishan
4. Baoquanshan
5. Yunfeng
6. Weiyuan
7. Shuifeng
8. Taipingwan
9. Shenwo
10. Taipingshao
11. Huilongshan
12. Huanren
13. Dahuofang

Cities:

14. Jiamusi
15. Harbin
16. Mudanjiang
17. Changchun
18. Jilin
19. Shenyang
20. Fushun

Rivers:

21. Tumen Jiang
22. Jiancre Jiang

Map Showing Distribution of Power Stations in the Three Northeast Provinces

9119
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## Gezhouba 170,000-Kilowatt Generators

Beijing GUANGMING RIBAO in Chinese 28 Dec 81 p 1

[Text] The correspondent of New China News Agency, Li Yongchang [2621 3057 7022] reports: The No 1 and No 2 water turbine generators of the Erjiang [Second Channel] Power Station of Gezhouba Water Conservancy Headquarters (see the Column "Information" on p 4) is officially in operation today after being inspected and accepted by the state.

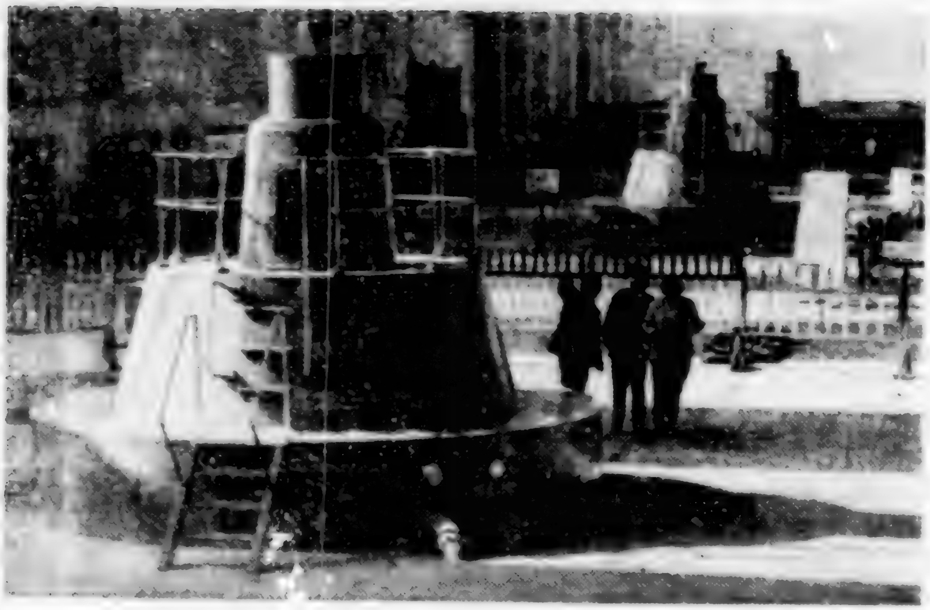
These generators have capacities of 17,000 kw each. This is a first power generating group installed and put into operation on the 10 thousand li main channel of Changjiang. On the average, the 2 generators can produce more than 18 hundred million kwh per year, the equivalent of the electricity generated by either 540 thousand tons of crude oil or 1.8 million tons of coal. From now on, the rolling water of Changjiang will contribute this gigantic quantity of electrical energy for the service of industryal-agricultural production and the livelihood of the people.

This morning, a solemn power generating celebration meeting was held at the Erjiang Power Station. In the speech by Li Daigeng [2621 0108 5087] Chairman of the Inspection and Switching-on Committee of the First Engineering Stage of Genzhouba Water Conservancy Headquarters and Deputy Minister of the Ministry of Electrical Power, he congratulated and praised the builders of Gezhouba for this new achievement of power generation following the successful blocking of water flow and opening of the river for navigation this year.

The 170,000 kw turbine generator is the largest rotary type low head generator designed and made in China and also among the largest low water head generators in the world today. Some problems occurred suddenly during testing since the No 1 generator was put in operation on 30 July. Following numerous load tests, various required experimental items were finally basically completed. Presently, the machines are operating normally and are producing the 170,000 kw power under the designed head. By the time of inspection and acceptance, the No 1 machine had produced an accumulation of 1.9 hundred million kwh of power. The installation of the No 2 machine was benefited by the experience of the No 1. The speed of installation was faster and the test run was much smoother. The members of the inspection committee unanimously acknowledged today that judging from the large quantity of technical data and the condition of the test operation, the 2 generators have been gradually perfected. The operation has been normal and the conditions for certified transfer and official production have been fulfilled. Their report also points out that this is the first research and manufacture of generators of this large a size in China. The time spent for test operation was not long. Continuous study after the machines have been in operatin to gain experience is needed to perfect the group of machines continuously so as to develop fully the economic benefit of these generators.

The Committee for Inspecting and Switching-on the Generators appointed by the National Construction Committee was composed of 23 members representing the Ministry of Electrical Power, the Ministry of Water Conservancy, the First [illegible]ry of Machines, the Ministry of Transportation, the Central China Bureau of El[illegible]cal

Power Management, the Gezhouba Engineering Bureau, the Changjiang Valley Planning Office, the Gezhouba Hydroelectric Power Generating Plant, the Dongfang Electrical Machinery Plant, Hubei Province, Yichang Prefecture, Yichang City, etc.



The No 1 (front) and the No 2 (center) water turbine generators of the Erjiang Power Station at Gezhouba are officially in operation to produce electricity. The No 3 generator (rear) is still undergoing test operation. Photo by New China News Agency Correspondent Hua Ai (5363 4114).

6168
CSO: 4008/207

## Generators Begin Operation

OW271224 Beijing XINHUA in English 1203 GMT 27 Dec 81

[Text] Wuhan, 27 Dec (XINHUA)--Two hydroelectric power generating units at Gezhouba Dam, the first ever built across the Yangtze River, were officially put into operation at a ceremony held this morning at the construction site in Yichang, Hubei Province.

Number one and two turbogenerator units at Gezhouba's Erjiang electric power plant, each with a designed capacity of 170,000 kilowatts, are expected to produce 1,800 million kilowatt hours of electricity a year. These are the biggest turbogenerator units China has ever produced.

Following the ribbon cutting ceremony presided over by Governor Han Ningfu of Hubei Province, a special committee, which supervised the installation and trial-operation of the units, signed an official report on the technical standards of the generating units.

The islands divide the course of the Yangtze River at Gezhouba into three channels. They are known as the "Dajiang" (the main channel, "Erjiang" (the second channel) and "Sanjiang" (the third channel). The Erjiang power plant is designed to have seven generator units with a combined capacity of 965,000 kilowatts. The other five units, each with a designed capacity of 125,000 kilowatts, will be put into operation in the next two years.

The number one and two turbogenerator units were designed and constructed in China. They are automatic, but can be operated manually or by remote control. There is an alarm system and in cases of emergency, the operation of the units shuts down automatically.

The turbines each weigh 2,160 tons. The water flow averages 1,130 cubic meters per second. Each generator weighs 1,635 tons. The entire generator unit is 48 meters high, as tall as a 16-story building.

The number one generator unit started trial-production on 30 July and the number two unit on 2 December. Up until today, they have produced approximately 190 million kilowatt hours of electricity.

Trial-operation of the units, on the whole, was smooth, said Li Daigeng, vice-minister of power industry in a speech at the ceremony.

CSO: 4020/60

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## Changjiang Harnessed, New Stations Built

Beijing XINHUA in English 0720 GMT 28 Dec 81

[Text] Beijing, 28 Dec (XINHUA)--Four big hydroelectric power stations are being built on tributaries of the Yangtze River in addition to the 2.71 million kw Gezhouba project which went into operation on the main course of the river 5 months ago.

The four are: the 630,000 kw Wujiangdu Station on the Wujiang (River) in Guizhou Province, the 800,000 kw Ankang Station on the Hanjiang (River) in Shaanxi Province, the 500,000 kw Dongjiang Station on a tributary of the Xiangjiang (River) in Hunan Province, and the Wanan Station, also 500,000 kw, on the Ganjiang (River) in Jiangxi Province.

Five big hydroelectric power stations with capacities ranging from 300,000 kw to 400,000 kw have been completed on Yangtze tributaries.

According to the Yangtze River Valley Planning Office, the river's water power reserves are among the greatest of all the rivers of the world. Only 2.6 percent of the reserves have been exploited, to date.

The 1,300 big, medium-sized and small hydropower stations that have been or are being built on the Yangtze and its tributaries have a combined capacity of 15 million kilowatts. Stations with a total capacity of seven million kilowatts have gone into operation.

Two extensive surveys were made of Yangtze River water resources after liberation, the first in the fifties and the second between 1977 and 1979. The data collected show that the Yangtze has water-power reserves of around 268 million kw, or 40 percent of those in all of China.

Li Zhennan, chief engineer of the Yangtze River Valley Planning Office, is one of the engineers who worked on the extensive surveys of the river basin. He said there are about one hundred sites suitable for building hydroelectric power stations with a capacity of over 250,000 kw each and a still larger number of sites for smaller stations.

Many of the sites are situated in inaccessible river gorges, Li Zhennan said. In the Hutiao Gorge on the Jinsha River that he had surveyed the water drops 200 meters in a distance of 16 kilometers providing an excellent site for a large hydropower project, but the mountains on both sides of the gorge rise to 5,000 meters above sea level and the river is hemmed in by steep rocky cliffs. "To reach the site we had to climb along many steep narrow paths. Later, roads were built to move in machines for geological prospecting," Chief Engineer Li said.

The surveyors had to work in areas subject to rock avalanches and landslides. They often forded turbulent rivers in small boats. They completed surveys of 1,090 large and small tributaries of the Yangtze between 1977 and 1979.

China has accumulated a wealth of experience in surveying, designing and building hydroelectric power stations, large and small, Li Zhennan said. Of the ten big hydro-power stations completed or under construction, six have dams over 100 meters high. The highest at Wujiangdu, reaches 165 meters. Dam types include concrete gravity, hollow gravity, double arch, barrage and earth and rock.

CSO: 4020/68

## Small Scale Projects

Guangzhou NANFANG RIBAO in Chinese 15 Nov 81 p 1

[Text] In the midst of [economic] readjustment, small hydropower construction continues to advance in Dapu County. This year, 11 hydropower stations were completed by October, with a total capacity of 3,094 kw, amounting to 343.7 percent of the provincial plan of 900 kw for the county. It is estimated that by the year's end the county will have a newly added hydropower capacity of about 4,000 kw. This county has already had 389 small hydroelectric power stations of a total capacity of 22,300 kw. From Jan to Sep this year, the county generated as much as 45,120 kwh of electricity, amounting to 104.9 percent of the quota for the year. Aside from meeting the power needs of industrial and agricultural production and the daily living of the people of the county, there was a surplus of 577 kwh of power being delivered to the power network of the prefecture.

Dapu County is extremely rich in hydropower resources. Ever since the Third Plenum of the Central Committee, the county committee and the county government have paid attention to developing the superior local advantage and treated small hydroelectric stations as an important measures in accelerating the economic construction of the mountainous regions. Last year a capital of 2.6 million yuan, a large quantity of lumber, steel, cement, etc. were allocated to help the communes and brigades to build small hydroelectric power stations. Meanwhile, the county committee and the county government also forcefully advocated and implemented the policy of "whoever builds it will manage it, own it, and be benefited by it. The communes and brigades are encouraged to construct their own power stations wherever and whenever there are sufficient water resources and capacity, with suitable capital supplement from the state and necessary technical guidance from the hydroelectricity department. In this manner, the various levels are fully mobilized to be positive about this matter. In the past year or so, the communes and brigades of the county have raised more than 1.16 million yuan of capital. The Tausing Brigade of Taoyuan Commune recently constructed a power station of 125 kw in capacity and the entire cost of 140 thousand yuan was contributed by the brigade itself. Now the county has 382 small hydroelectric power stations that are built by the communes and brigades themselves. They have a capacity of 14,300 kw plus, amounting to roughly two-thirds of the total power capacity of the entire county.

6168
CSO: 4006/208

## Briefs

YARLUNG ZANGBO RIVER HYDROPOWER--Hydropower reserves of the famous Chinese river Yarlung Zangbo in Tibet are as high as 110,000,000+ kilowatts, second only to those of the Chang Jiang. Today, installed hydroelectric power capacity on this river has reached 45,000 kilowatts. Electric power has begun to serve production and construction on the plateau and has provided many Tibetan farmers and shepherds on high mountains and in deep valleys with a new life in which "lighting needs no oil and work needs no draft animals." The Yarlung Zangbo River springs from the rises in the Himalayas at an elevation over 6000 meters and flows to the valley in southeast Tibet where the elevation is only a few hundred meters. The vertical water head is more than 5000 meters with a dozen cataracts in between, frequently several dozen meters at one fall. [Beijing GUANGMING RIBAO in Chinese . Nov 81 p 1] 9698

CSO: 4006/124

GANSU HYDROELECTRIC STATION--Liujiaxia Hydroelectric Station, the biggest one in China, fulfilled its annual power production plan 21 days ahead of schedule. The total output value of the station reached 285 million yuan as of 8 December. [Lanzhou Gansu Provincial Service in Mandarin 1125 GMT 11 Dec 81 SK]

# METHANE DEVELOPING AS SUBURBAN, RURAL ENERGY SOURCE

## Wujin 8-kw Experimental Station

Chongqing XIN NENG YUAN [NEW ENERGY SOURCES] Vol 3, No 5, 5 Oct 81 pp 36-40

[Article by Mao Hexin [3029 5440 7451] of the Institute of Power Construction, Ministry of Electric Power: "8-Kilowatt Methane Gas Power Generation Experimental Station at Wujin, Jiangsu"]

[Text] In October of 1978, the Institute of Power Construction was entrusted by the Ministry of Electric Power to organize three units involved in methane gas research in Sichuan, Guangdong and Jiangsu to investigate small rural area power facilities in China, standard of electricity for agricultural use, supply and sales of diesel fuel and source of fermentation material for methane gas. It was proposed that the popular S195 diesel engine broadly used in Chinese rural areas be converted to a single-fuel engine burning methane gas and establish an 8-kilowatt methane gas electric power generating experimental station to gain experience in power generation from methane gas in China's rural areas. With the coordinated effort of the Jiangsu Methane Gas Research Institute, the Wujin Diesel Engine Plant and the Wujin Electric Machinery Plant, China's first single-fuel methane gas electric generating experimental station passed the evaluation by the Ministry of Electric Power in April 1981 and officially began generating electricity. The system was found to have good operating performance and the quality of the electric power produced met the requirements of agricultural use.

### I. The basic flowsheet of the experimental power station

The experimental power station occupies a land area of 750 square meters and its basic flowsheet is shown in Figure 1.

Fresh manure flows automatically from charge inlet port 1 into two interconnected ambient temperature digesters 2 and 3. It may also be pumped from another charge intake port by pump 4 into an upright heated digester 5 on the ground. All the methane gas produced are fed into two-stage carbon dioxide and hydrogen sulfide absorbers 7 and 8 through gas pipe 6 for purification. The purified methane gas then enters a 20-cubic-meter steel floating-cover gas storage tank 9 and is then fed through gas pipe 10 into methane gas engine 11 where it is burned and does work by pushing against the piston. The electric power produced by the electric generator 12 is then transmitted to the users by the electricity central control panel 13.

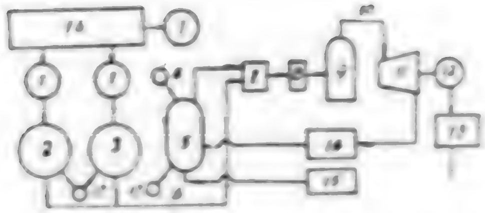

Fig. 1 Basic flowchart of power station

Key:
1. Charge inlet
2,3. Ambient temperature digester
4. Input and output pumps
5. Heated digester
6. Gas pipe
7. Carbon dioxide purifier
8. Hydrogen sulfide purifier
9. Floating-cover gas storage tank
10. Gas pipe
11. Methane gas engine
12. Electric generators
13. Electricity and gas control panel
14. Residual-heat water tank
15. Solar powered hot water heater
16. Pig pen
17. Discharge port

Fermentation in the ambient temperature digester is continuous, with a period of 30 days. Each digester takes 400 kilograms of fresh manure and 650 kilograms of water per day, the content of solid matter in the fermentation liquid is about 5 percent.

The heated digester makes use of the residual heat at 14 from the circulation water of methane engine and heat from a 36 square meter planar solar hot water heater 15. Design temperature is 30°±1°C, input charge is a mixture of rice straw and pig manure. Period of the batch fermentation is 60 days, dry matter composition ratio in the batch is 1 : 3.65 and carbon to nitrogen ratio is 25 : 1.

Methane engine takes gas from the floating-cover storage tank. The gas may be allowed to separate spontaneously to raise the methane content at the top of the storage tank. This stabilizes the intake gas pressure, develops the engine power and reduces engine vibration.

## 1. Brief description of the digesters and the electric generator

Ambient temperature digesters: There are two ambient temperature digesters each has a volume of 30 cubic meters, a diameter of 5 meters and a height of 2.55 meters. They are cylindrical in shape, have movable covers and are constructed of hydraulic brick.

Heated digester: The diameter is 6.12 meters, the height is 5 meters and the effective volume is 50 cubic meters. Its interior has three chambers to facilitate comparison and is equipped with snaking heat exchangers. The body structure is brick with steel reinforcement, the cover is poured concrete, the wall insulation is 10 centimeters of rice straw.

Methane engine: Based on the S195 diesel engine, the starting mode, ignition device, governor mechanism, and cylinder compression ratio are modified. The engine's fuel supply system is removed and an air-methane mixer is added.

(1) Since the heat value and ignition point of methane are quite different from those of diesel fuel, it is difficult to start a methane engine by a hand crank. Therefore, a starter motor is installed at the location of the original gas tank and the engine is converted to electrical start by installing a cogwheel on the outer rim of the flywheel.

(2) The ignition system consists of battery, high-voltage coil, distributor, and spark plugs. Considering that the electric generator will operate under different loads, medium-heat spark plugs are used to prevent serious carbon build-up and stall. The spark plugs are installed at the locations of the original fuel injectors and the angle should allow rapid flame propagation after ignition.

(3) Cross-flow mixing of air and methane intake is used in the design of the air-methane mixer. Since the actual methane content in the produced marsh gas is not constant, a mixer that tracks the variation of methane content would be costly and complex to design. Based on actual measurements, the engine works well at an air-methane ratio of 1 : 5 ~ 5.5, see Figure 2.

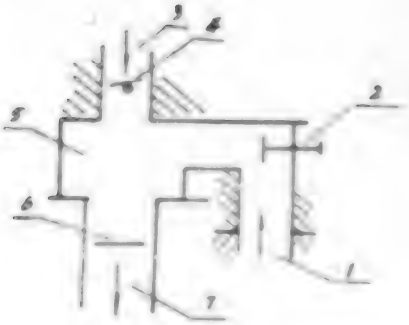

Fig. 2 Schematic diagram of the mixer

Key:
1. Methane gas intake
2. Methane gas adjustment handwheel
3. Air intake
4. Air intake-valve plate
5. Mixing chamber
6. Control valve for mixture
7. Mixture outlet

(4) The governor gear makes use of the original speed control disk and governor lever. A set of speed control arms is added (see Figure 3) to adjust the intake automatically and to stabilize engine revolution speed when the load fluctuates.

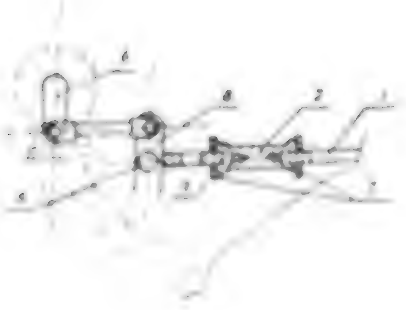

Fig. 3 Schematic diagram of the governor

Key:
1. Long drag link of the governor arm
2. Governor rod
3. Short drag link of the governor arm
4. Large rocker arm
5. Coupling joint
6. Small rocker arm
7. Round-head screw

(5) An optimum cylinder compression ratio is very important to the output power of the engine. Based on repeated adjustments and tests, the compression ratio of the methane engine should be 13.7. The compression ratio of the original diesel engine is reduced mainly by changing the shape of the cowl hood and the top surface of the piston, thereby increasing the effective volume after compression.

Considering the characteristics of the dynamic load in agricultural use, the output power level of the motor should be raised to match the 8-kilowatt electric generator. The rotational speed is therefore raised from 2000 rpm to 2200 rpm. Dynamic calculations made on major components of the engine showed that safety coefficient is within the allowed range and thermal efficiency is greater than 29 percent.

Electric generator: The electric generator is an automatic, constant-voltage, three-phase, synchronous generator designed specially by the experimental power station. It uses third harmonic magnetic excitation, has good starting performance and the efficiency is better than 83 percent.

3. Operating conditions of the experimental power station

We have repeatedly tested the major technical parameters of the electric generator under the following operating conditions (unless specified to be actual power, power values are nominal):

(1) Operate with 2.2-kilowatt outlet pump and 8-kilowatt resistive furnace, then unload the resistive furnace completely.

(2) Operate with 4.5 kilowatt water pump and 2.2 kilowatt outlet pump, then unload outlet pump.

(3) Operate with 8 kilowatt load of resistive furnace, followed by reducing the load to 1/2 and then go back to full load of 8 kilowatts (actual power) before total unload.

Data collected in these tests are tabulated in Table 1. Calculation results for these operating conditions are listed in Table 2. As can be seen, under these different operating conditions the terminal voltage of the generator is stabilized at 378~410 volts. When the power factor is close to unity and the generator is run with 6.2 to 8 kilowatts of work load, 1 cubic meter of marsh gas (with a methane content of 62.6 percent) generates 1.55 kilowatt-hours of electricity and the overall thermal efficiency is 24-25 percent. When the generator is unloaded from 8 kilowatts of full load, the governor rate of the motor is less than 4 percent. The generator is capable of starting an asynchronous motor directly from no-load.

Table 1. Test results of methane generator under three different operating conditions

| 工况 1 | 序号 | 发电机 2<br>电流(安) 3<br>A | <br><br>B | <br><br>C | <br>电压(伏) 4<br>AB | <br><br>BC | <br><br>CA | 频率(赫) 5 | 功率因数 6 | 沼气机转速 7<br>(转/分) | 沼气 8<br>压差 9<br>ΔH | <br>流量(米³/小时) 10 | <br>成分% 11<br>$CH_4$ | <br><br>$CO_2$ | <br><br>$O_2$ | <br><br>CO | 负荷 12<br>功率(瓦) 13<br>$W_1$ | <br><br>$W_2$ | <br>形式 14<br>电动机 15<br>(千瓦) | <br><br>电阻 16<br>(千瓦) | 发电量(千瓦小时) 17 | 测试时间(分) 18 | 备注 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | 1 | 11.6 | 11.5 | 11.96 | 384 | 386 | 388 | 50.0 | 0.978 | 2200 | 14.0 | 4.67 | 62.6 | 36.8 | 0.4 | 0.2 | 4380 | 7808 | 2.2 | 6.0 | 0.611 | 8 | |
| | 2 | 8.0 | 7.0 | 8.0 | 396 | 398 | 396 | 50.5 | 0.932 | 2270 | 11.5 | 3.84 | 62.6 | 36.8 | 0.4 | 0.2 | 2820 | 2040 | 2.2 | 3.0 | 0.400 | 8 | 甩电阻 20 |
| II | 1 | 15.2 | 15.0 | 17.4 | 404 | 406 | 403 | 51.[illegible] | 0.785 | 2210 | 12.9 | 4.00 | 62.6 | 36.8 | 0.4 | 0.2 | 4480 | 1500 | 4.5<br>2.2 | | 0.464 | 5 | |
| | 2 | 6.4 | 6.6 | 7.6 | 406 | 400 | 400 | 51.3 | 0.834 | 2270 | 10.3 | 3.50 | 62.6 | 36.8 | 0.4 | 0.2 | 2760 | 1380 | 4.5 | | 0.772 | 8 | 甩2.2千瓦泵 21 |
| III | 1 | 11.5 | 11.1 | 11.4 | 380 | 378 | 379 | 50.0 | 1 | 2210 | 13.5 | 4.50 | 62.6 | 36.8 | 0.4 | 0.2 | 3940 | 3900 | | 8.0 | 0.582 | 8 | |
| | 2 | 9.4 | 6.4 | 9.9 | 404 | 400 | 400 | 52.0 | 1 | 2270 | 12.5 | 4.17 | 62.6 | 36.8 | 0.4 | 0.2 | 3360 | 3360 | | 6.0 | 0.522 | 8 | 甩1/3电阻 22 |
| | 3 | 11.0 | 11.2 | 11.6 | 392 | 390 | 390 | 50.0 | | 2310 | | | | | | | 4020 | 4020 | | 8.0 | | | |
| | 4 | 0 | 0 | 0 | 400 | 400 | 400 | 54.0 | 1 | 2340 | | | | | | | | | | 0 | | | 全卸载 23 |

Key:

1. Mode (of) operating condition
2. Electric generator
3. Current (amperes)
4. Voltage (volts)
5. Frequency (Hertz)
6. Power factor
7. Methane engine speed (rpm)
8. Methane gas
9. Pressure differential
10. Flow rate ($m^3/hr$)
11. Composition (%)
12. Load
13. Power (watts)
14. Type of load
15. Electric motor (kilowatts)
16. Resistance (kilowatts)
17. Output power (kilowatt-hours)
18. Testing time (minutes)
19. Remarks
20. Uncoupling resistance
21. Uncoupling 2.2 kilowatt pump
22. Uncoupling 1/3 resistance
23. Total disconnect

Table 2 Calculated results of major specifications of the methane generator

| 运行工况编号 1 | | 小时耗沼气量 (米$^3$/小时) 2 | 单位千瓦小时耗沼气量(米$^3$/千瓦小时) 3 | 发电机组热效率 (%) 4 | 沼气发动机调速率 (%) 5 | 电能频率品质 (%) 6 |
|---|---|---|---|---|---|---|
| Ⅰ | 1 | 4.67 | 0.64 | 25 | | |
| | 2 | 3.84 | 0.80 | 20 | 3.18 | 1.0 |
| Ⅱ | 1 | 4.00 | 0.72 | 22.3 | | |
| | 2 | 3.50 | 1.07 | 15 | 2.49 | 0.2 |
| Ⅲ | 1 | 4.50 | 0.64 | 25 | | |
| | 2 | 4.17 | 0.666 | 24 | 2.72 | 4.0 |
| | 3 | | | | | |
| | 4 | | | | 5.88 | 8.0 |

Key:
1. Code for operating conditions
2. Methane consumption ($m^3/hr$)
3. Methane consumption per kilowatt-hour ($m^3/kwh$)
4. Thermal efficiency of generator (%)
5. Speed governing rate of methane engine (%)
6. Frequency quality of electric power (%)

## 4. Analysis of economic efficiency

Table 3 shows the capital construction investments of an 8-kilowatt single-fuel methane generator station if the design (equipment and flowsheet) of the experimental station is slightly modified (as discussed in Section 5). The total investment is approximately 11,000 yuan and the investment per kilowatt-hour is 1,375 yuan.

Table 3 Capital construction investments of the generating station

| 主要项目 1 | 规格 2 | 元 3 |
|---|---|---|
| 常温发酵池 4 | 100立方米 | 2,000 |
| 加温发酵池 5 | 50立方米 | 2,200 |
| 贮粪池 6 | 50立方米 11 | 500 |
| 储气柜 7 | 20立方米 | 1,500 |
| 发电机组 8 | 8千瓦 12 | 2,000 |
| 简易加热装置 9 | | 1,500 |
| 其它 10 | | 1,300 |

Key:
1. Major items
2. Specification
3. Cost (in yuan)
4. Ambient temperature digester
5. Heated digester
6. Manure pool
7. Gas storage tank
8. Generator
9. Simple heating device
10. Miscellaneous
11. Cubic meters
12. Kilowatts

With the abundant fermentation material for producing marsh gas in Jiangsu, the two-stage fermentation method may be used. The average monthly rate of gas production [in cubic meters] per cubic meter volume of ambient temperature digester may be computed as follows: 0.1 for November through February (with proper insulation in winter); 0.17 for March through May; and 0.25 for June through October. On average, 18 cubic meters of gas can be produced per day in a 100 cubic meter ambient temperature digester. For heated digesters, the rate of production may be taken as 0.8 and the rate of gas loss taken as 30 percent. For a 50 cubic meter heated digester, the average net gas production per day is 28 cubic meters, with proper operation and management, an annual production of 24,000 kilowatt-hours of electricity is no problem. At an average electricity cost of 0.15 yuan/kilowatt-hour for agricultural lighting and power, a revenue of 3,600 yuan per year can be realized at a production cost of 0.075 yuan/kilowatt-hour. This will not only greatly cut down the consumption of diesel fuel and other energy resources, the amount of money made is enough to support a shift worker and all the investments may be recovered in 3-4 years.

If the volume of an ambient temperature digester is increased to 150 cubic meters (an additional 1000 yuan for capital construction investment) and the rate of gas production is raised to an annual average of 0.2, then, the annual production of electric power will be 30,000 kilowatt-hours and the entire investment may be recovered in a little over 2 years. In some of the southern provinces where the annual average temperature is higher, the economic benefits will be even more pronounced.

## 5. Questions and conclusions

The methane generator at Wujin is an experimental station built to explore power generation in rural area from methane gas and to accumulate experience in this area. Even taking out the costs that are research in nature, the investments still greatly exceed those listed in Table 3. When power generation from methane gas is promoted in the rural area, some of the systems and equipments used in the Wujin experimental station must be modified to lower the construction costs. The cost of the digester generally amounts to more than 60 percent of the total investment of the generating station. Questions such as whether a two-stage fermention or a single-stage fermentation should be used in small rural methane gas power stations, and, for a fixed total volume of the digester, what should be the ratio of the volume of the two stages and what should be the volume of single digesters must be answered after further investigation from economic, technological and management points of view. Moreover, the current cost of a methane engine is still higher than that of the original diesel engine. The ignition method should be improved and the battery should be eliminated to lower the cost. (Wujin Diesel Engine Plant is currently working on this.)

As compared to pure diesel fuel electric generator, the methane-diesel dual-fuel generators in wide use in rural areas of China can generally save 75-80 percent of fuel. We have made repeated tests on the Wujin Benniu-40 kilowatt dual-fuel electric generator and found its thermal efficiency to be only 17 percent. The thermal efficiency of the S195 dual-fuel methane engine (not a generator) modified by Shanghai Institute of Internal Combustion Engines is also only 26.4 percent (taking heat value of methane as 5000 kilocalorie per cubic meter.) Therefore, the energy of the fuel-gas mixture has not been exploited to the fullest. As stated above, the thermal efficiency of a single-fuel methane electric generator is already more than 24 percent. With losses in the generator and belt drive efficiency taken into account, the generator efficiency is approximately 30 percent. This indicates that methane burns better than the dual-fuel. Of course, the promotion of single-fuel methane power generation is more constrained by the availability of fermentation material than the dual-fuel power production; however, since the efficiency of rural marsh gas production has been continuously on the rise, the prospects of power production from marsh gas is very bright indeed.

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CSO: 4006/159

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## Suburban Uses

Beijing HUANJING BAOHU [ENVIRONMENTAL PROTECTION] in Chinese No 4, 1981 pp 31-32

[Article by Zhu Hongqian [2612 7703 6870]: "Methane in Towns"]

[Text] The production and extraction of methane as a form of bioenergy has already developed from normal temperature natural anaerobic fermentation used in rural areas to the medium to high active mud production method used in towns. This method can treat organic wastes of industry, protect the environment and retrieve energy.

### China's Urban Methane

The utilization of methane in our nation has already begun to move from the household sector to the productive sector, and it is rapidly developing from the rural areas towards the cities. According to statistics, there are over 30,000 large installations in towns, mostly distributed in Guangdong, Jiangsu, Shandong, Shaanxi provinces. They mainly treat organic waste water and human excrement in cities and they have shifted emphasis to comprehensive utilization of industrial wastes to realize a double benefit of treating pollution and retrieving energy.

The Dongshan Ward Environmental Sanitation Department of Guangzhou City utilizes the city's human excrement to produce methane as a substitute for diesel oil used to generate electricity. The power station has an installed capacity reaching 500 kilowatts. Each day, it transmits over 2,000 kilowatt-hours of electricity to the power network.

The Nanyang Alcohol Plant of Henan province releases over 400 tons of waste liquid from the distillation of alcohol a day, which drains into the rivers and causes serious pollution. Since building a 4,000 cubic meter methane pit, the pollution has improved, and the pit also produces over 6,000 cubic meters of methane a day as fuel for the boilers, conserving about 1,000 tons of coal a year.

Our nation has a rather large number of wineries, paper manufacturing, foodstuff manufacturing, sugar refining, pharmaceuticals and such light industries and chemical industries. Each day, the amount of dissolvable organic waste water released is large. Most of it is low concentration (below 1 percent) wastewater which is not rationally utilized and is directly released, causing pollution everywhere. The Guangzhou Energy Institute aimed at the problem of treating low concentration wastewater, used the residue liquid of distiller's grains as the subject of research for nearly over a year and obtained welcome results. They utilized the anaerobic filters of some filling materials. When the concentration of the input materials was 9,000 milligrams/liter, the operating load could reach 7.26 grams COD/day liter, each gram of COD could produce 543 milliliters of gas, the gas production rate reached 3.94, the lingering time of the liquid was only 1.24 days, and the rate of elimination of COD reached 83.8 percent. This achievement has established a theoretical basis for the development of methane in our nation's towns. At present, this research has already developed from the laboratory stage to the practical demonstration stage of treating wastewater from sugar refining and paper manufacturing.

## Urban Methane Has Benefits Which Should Not Be Underestimated

The amount of bioenergy consumed each year in our nation constitutes about 30 percent to 35 percent of the total energy consumption. Bioenergy resources are very rich, but most of the bioenergy has not been utilized well. Some people have calculated that its utilization rate is less than 8 percent. In addition, the massive amounts of organic waste from industrial production have not been utilized. In the wastewater from paper manufacturing alone, each year the amount released throughout the nation contains 4,500,000 tons of organic matter. If this is used to produce and extract methane, each year, 1.125 billion cubic meters can be obtained. This could generate 1.68 billion kilowatt-hours of electricity, a truly attractive figure!

In some towns where industry is relatively concentrated, combining the treatment of pollution with the development of industrial methane in a big way can produce a sizable economic gain. For example: according to statistics compiled by the environmental protection department of Shenyang City, the usable portion of organic waste water released by industry each day is over 100,000 tons. If all of it is used to produce and extract methane, the amount of energy retrieved each year is equivalent to 8,000 to 9,000 tons of standard coal. The city's human excrement, if used to produce methane and for retrieval of energy, are equivalent to over 60,000 tons of standard coal a year. Anaerobic treatment of organic garbage each year can retrieve an amount of energy equivalent to 12,000 tons of standard coal. Calculating at the present domestic level, the city can retrieve an amount of energy from organic waste equivalent to over 80,000 tons of standard coal. This figure is equivalent to 2 percent of the total energy consumption in Shenyang City at present. If the treatment is of international standard, then it is estimated that Shenyang City can obtain 10 percent to 15 percent of its energy from mass produced methane.

9296
CSO: 5000/4004

## Zhijiang's Applications Fit Local Needs

Wuhan HUBEI RIBAO in Chinese 4 Oct 81 p 2

[Article by staff correspondent: "Zhijiang County Produces Methane Quickly and Well"]

[Text] The party committees and government at each level in Zhijiang County have taken active and steady steps to focus on this year's construction of methane. Up to the end of August, the whole county has already built 4,596 methane pits, constituting 76.6 percent of the contracted task for the whole year. The progress has been fast and the quality is good.

An important characteristic of methane construction which has been grasped by the leading comrades of the party and the administration of this county is suiting measures to local circumstances and providing guidance in separate categories. They have divided the whole county into four categories: the first category includes one commune, 49 brigades and 371 production teams that have already basically popularized methane. [They will concentrate] mainly on managing and using methane well. The second category includes the two communes of Bailizhou and Qixingtai, 68 brigades and over 700 production teams that have enthusiastically built methane pits. [They will concentrate] mainly on building pits. The third category includes localities where original efforts to build methane were hindered. [They will concentrate] mainly on repairing unhealthy and abandoned pits. The fourth category includes localities that presently have difficulty in capital. [They will concentrate] mainly on building model pits. Grasping the work in this way has brought out the key points, and leadership, capital, techniques and materials can all be rationally arranged.

During the course of building the pits, this county conscientiously implemented the policy of "having the commune members produce methane as the key measure with assistance provided by the state and the collective." All farm families that build pits are given appropriate assistance in the three aspects of "labor, money and foodgrain". This year, the whole county has arranged for an investment of 500,000 standard working hours, 200,000 yuan in cash, and 200,000 jin of food grain, all to be directly subsidized to the families building pits. To ensure quality of the pits, they paid attention to the training of methane technicians. Since the beginning of this year, 15 training classes for methane technicians were held, and the number of farmer methane technicians participating in training totaled 704. Among them, 325 persons passed the examinations and were issued technician's certificates. This group of farmer technicians is exercising a backbone function in the building of methane.

9296
CSO: 4006/96

## Methane-Energy Villages Established

Wuhan HUBEI RIBAO in Chinese 4 Oct 81 p 2

[Article by staff correspondent: "Hubei Establishes a Group of Methane Energy Villages on a Trial Basis"]

[Text] To explore the experience of using methane gas year round, in January of this year, the provincial methane office and concerned regional and city methane offices signed a contract to establish a methane energy village of 3500 families on a trial basis. At present, the energy villages are being built.

The basic requirement in building a methane energy village is that each family must build two 6 to 8 cubic meter pits. These are connected to the lavatories and the pig pens to facilitate management and repair, to rotate the flow and change the materials for balanced production of gas, to extend the useful life of the pits, and to ensure that the farm families can use methane gas as fuel for cooking three meals a day throughout the year. According to this requirement, the province provided all necessary support in capital and cement. During the first half of the year, some of the methane energy villages have already been built and received benefits. The Sixth Production Team of the Baofeng Brigade of Jiufeng Commune in the Hongshan Ward of Wuhan City only has 12 families. Each family has built double pits, all are being used, and the commune members all say the methane gas is good. During the course of establishing the methane energy village, the Sixth Production Team of the Liulinqiao Brigade of the Oumiao Commune in Xiangyang County combined the construction of methane gas with accumulation and production of fertilizers and improvement of environmental hygiene. All aspects were designed and constructed together. Each farm family built a double methane pit connected to the pig pen and the lavatory, and at the same time, a pump water well, a flower bed, and a fish culture pond were built. Of the 54 families of the whole team, 27 families have already completed the construction task according to plan. Commune member masses happily said: "In the past, human excrement and animal excrement could be found everywhere, and dirty mud and dirty water flowed everywhere. Now, every family's courtyard is like a garden. The whole village is as clean as a picture."

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CSO: 4006/96

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## Safe Use Urged

Wuhan HUBEI RIBAO in Chinese 4 Oct 81 p 2

[Article: "Safe Use of Methane"]

[Text] 1. Prevent suffocation and poisoning. Methane gas generally contains 60 percent to 70 percent of methane. Methane itself is a nonpoisonous and easily combustible gas, but when its concentration in air reaches 30 percent, it can cause people to faint, and when the concentration reaches over 70 percent, it can cause death by suffocation because of a lack of oxygen. At the same time, methane gas also contains carbon monoxide, hydrogen sulfide, trihydric phosphide and such poisonous gases which can easily poison people. Therefore, when extracting large amounts of material or when maintaining the pits, the cover should first be removed to expose the entrance and exits for materials for three days before people enter the pit. Raw materials with a high content of phosphorus such as vegetable cakes, cottonseed cakes and phosphorous fertilizers should not be put into the pit to prevent the production of trihydric phosphide.

2. Prevent burning. When using methane gas, one must first light the fire, then turn on the switch. Whenever a smell of rotten eggs is present inside the house, this means there is a leak in the pipes. At this time, the windows and doors must immediately be opened and the pipes should be checked and repaired. Never light a fire. When maintaining the methane pit, do not carry an open flame into the pit.

3. Prevent explosions in the methane pit. Determining whether a newly built methane pit is producing methane gas can only be done by using pipes to conduct the gas to lamps or stoves to test the flame. Lighting the mouth of the exit tubes or liquid surfaces inside the entrance or exits for materials is prohibited to prevent causing the returning flame to set off a blast and damage the methane pit. When the pressure in the water column is small and when taking out some manure, lighting and using the gas should be temporarily halted, because when a switch is turned on at this time, the gas will flow back, leading the flame into the pit and thus causing an explosion inside the pit. After completing the methane pit, gas pipes or gas regulating pipes must all be opened when adding water, adding material, testing water, testing gas or taking out large amounts of materials to prevent overly large negative pressure or positive pressure and destruction of the pit.

4. Prevent people and animals from falling into the pits. The entrance and exit of the methane pits must be covered with strong materials.

9296
CSO: 4006/96

## Briefs

METHANE GENERATED FROM GARBAGE--The dairy farm in Wenquanzheng in Xianning County has fully utilized polluted water, cow dung and urine to produce methane and basically solved the problems of fuel for production and for living. This farm is a small farm operated by the town, it now has 6 workers and it raises 11 dairy cows. Annual yield of fresh milk amounts to over 60,000 jin. In the past, everyday it produced 1,000 jin of polluted water and polluted substances, which was allowed to flow everywhere. This was a waste of resources and it seriously polluted the environment. Last September, this farm invested 760 yuan under the support of concerned departments of the region and built a 21-cubic meter methane pit. During the middle ten days of October, use of the pit began. From then on, boiling and disinfecting milk, and cooking and boiling water by the workers have all used methane as fuel. Over 3,600 jin of coal can be conserved each year and environmental hygiene is greatly improved. [Text] [Wuhan HUBEI RIBAO in Chinese 4 Oct 81 p 2] 9296

METHANE PIT DREGS UTILIZED--The Mianyang county methane experimental station has utilized the dregs left over after fermentation of methane at the end of last year to cultivate mushrooms, and has obtained preliminary results and opened up a way for the comprehensive utilization of methane. Dregs of methane pits are the residues of various kinds of organic matter after anaerobic fermentation and after production of methane. They contain rich nutritive substances. According to measurements, dregs of methane pits generally contain 30 percent to 50 percent of organic substances and 5 percent to 9.4 percent of coarse protein, and some other minerals and growth stimulants which can satisfy the needs for the growth and development of edible fungus. This experimental station utilized dregs from methane pits to experimentally cultivate 10 square meters of mushrooms and harvested over 300 jin. The residual dregs after cultivating edible fungus still contained 80 percent of organic substances that could be returned to the fields, not affecting the need of farmland for organic matter. At present, the mushroom growing season has arrived. This station is carrying out new experiments. [Text] [Wuhan HUBEI RIBAO in Chinese 4 Oct 81 p 2] 9296

TUOSHI COMMUNE METHANE PITS--The Tuoshi Commune of Tianmen County established a commune concrete methane pit prefabrication plant to hasten the completion of this year's methane pit construction task and provided materials for farm families and some units directly subordinate to the communes to build methane pits. Such materials have been used to build five pits and they are now being used and are producing normally. Using this method to build methane pits costs less, the period of building the pits is short, the quality is reliable, and ordinary farm families can afford it. Prefabrication of one methane pit of 8 to 10 cubic meters requires prefabrication of 80 pieces, 450 jin of cement, 1,300 jin of sand, 2,300 jin of stones, and the cost is 40 yuan (not including labor cost). Installation and plastering requires another 700 jin of cement. The materials needed to build the pits are provided by the plant itself. After the pits are built, they are sold for 85 yuan each to the users. If the pits leak water and leak gas, the materials and labor required to rebuild the pit are all born by the plant. This plant plans to produce prefabricated components for 500 pits this year. At present, it has accepted the task of building 200 pits. [Text] [Wuhan HUBEI RIBAO in Chinese 4 Oct 81 p 2] 9296

BIOGAS DIGESTERS DEVELOPED--The agricultural machinery plant of Yinjiafu Commune in Shunyi County has successfully developed biogas digesters. In recent evaluations by the departments concerned, these machines are regarded as beneficial to the utilization and development of biogas as an energy source and should be vigorously promoted in the entire suburban area. As a new source of energy, biogas is being promoted in suburban areas step by step. According to statistics, they are 28,000 biogas tanks today in suburban communes and brigades. The response of the people is that these biogas tanks cannot be stirred and getting the output is a serious problem. Since these tanks are filled with great quantitites of methane gas and the operator needs to get into the tank to clean out the stuff, the slightest slip-up may cause suffocation. There have been a number of deaths in the suburbs in recent years. Some commune members were afraid to build biogas tanks because of the fear of accidents and some tanks already built were abandoned or destroyed. The output machine built by Yinjiafu Commune agricultural machinery plant makes use of a sewage centrifugal pump and is equipped with a water spray gun. In addition, specially made cutting blades are installed at the intake of the water pump and around the edges of the impeller blades for chopping up branches, grass and hard shells and the output is stirred and blended. The entire machine is mounted on a combination push-cart and is very flexible and convenient to move around. From installing the machine to completing the operation, it takes only 40 minutes to handle a 10 cubic meter biogas tank. Each production brigade needs only one unit for their members to use. [Text] [Beijing BEIJING RIBAO in Chinese 14 Oct 81 p 1] 9698

CSO: 4006/115

FIRST METHANE-POWERED ENGINE--The Wujin Diesel Engine Plant in Jiangsu Province has successfully developed China's first single-fuel 8-kilowatt methane engine. The engine is a modification of the popular S195 diesel engine used in today's rural villages. At an operating load of 6.5 to 8 kilowatts, one cubic meter of methane can generate 1.5 kilowatt hours of electricity. Eight kilowatts of power can be supplied within the range of certain currencies and frequencies. Our research personnel as well as Japanese and other foreign experts believe that this methane-powered engine, set up as an 8-kilowatt power station using new energy resources, will mean a bright future for rural villages. Purchase orders have been placed by such nations as Madagascar, the United States and Australia. [Text] [Beijing GUANGMING RIBAO in Chinese 4 Jan 82 p 1]

CSO: 4006/96

## SOLAR, WIND, GEOTHERMAL POWER DEVELOPING

# Research in Suzhou

Chongqing XIN NENG YUAN [NEW ENERGY SOURCES] Vol 3, No 5, 5 Oct 81 pp 35-36

[Article compiled from "Research Report Abstract" provided by Suzhou Municipal Research Institute for Energy Conservation Equipment and Suzhou Solar Energy Equipment Plant, May 1981: "Solar Energy Equipment Research in Suzhou News in Brief"]

[Text] The China Solar Energy Society is now organizing its 1981 annual meeting and various units are preparing to submit research reports and data to the conference. Four reports have been submitted by the Suzhou Municipal Research Institute for Energy Conservation Equipment and the Suzhou Solar Energy Equipment Plant:

1. Design investigation of the STR 79-R box type planar solar collector (co-authored by Yao Maohong [1202 5399 3163] and Chen Jiaying [7115 0163 5391]).

This report gives a general introduction to the low-temperature, high-efficiency collector and its construction, heat transfer mechanism, thermal equilibrium analysis, performance characteristics and technical features. Several solar hot water heater systems built around this type of solar collector are also recommended in the report. The absorber of this solar collector is a thin-walled box. Instead of being soldered, the top and bottom covers are attached using a unique joining and sealing technique that eliminates the potential corrosion problems left by the solder flux. More importantly, the water path within the absorber makes use of a planar integrated collector tube and upper and lower coupling tubes. This structure allows the maximum heat transfer, is easy to manufacture and convenient for industrial operation. The case of the collector is made of fiberboard material which is immune to rainwater corrosion, extends the useful life of the collector and greatly reduces the cost as compared to iron case units. These collectors are now being mass-produced.

2. Fixed temperature water outlet control in heat retaining hot water heating system (authored by Yang Zhenhuan [2799 7201 3883] and Wang Sumin [3769 5695 3046]).

In a planar solar collector, the plates are arranged in series, in parallel, or in a combination of the two. Combined with a circulation water tank, this constitutes a solar powered hot water heating system. In general, 10 collectors are used as a unit which has 15 square meters of area. In Type 1 through Type 4 solar radiation resource areas with 6 hours of sunlight or more, each square meter of collecting area may produce 100 kilograms of 40-65°C hot water per day. However, since this system has a large number of pipes and hence a large heat dissipation area, the heat loss is correspondingly high. If a heat-retaining fixed temperature water outlet scheme is used, investments on the pipes will be cut down and the circulation water tank and the compensator water tank can be eliminated. This will raise the thermal efficiency of the system and increase the amount of hot water produced. The heat-retaining water system may either use a single unit of collector or many units; the greater the collecting area, the more pronounced are its advantages. In this system, a temperature activated mercury switch controls the lower limit of the temperature, either 40°C or 50°C, and the corresponding upper limits are 50°C and 60°C. If the 50-60°C range is selected, then, when the temperature at the sensing point reaches 60°C, the drive system consisting of the temperature activated mercury switch and a self-locking circuit will open a solenoid valve and force the system to let out hot water while cold water is supplemented through an inlet at the bottom of the collector. When the temperature at the sensing point drops below 50°C, the drive system closes the solenoid valve and the system goes back to heat-retaining mode. In addition, a time control is also included in the control circuit so that the system has both temperature control and time control. The water outlet system can also be operated manually at dusk to drain all the hot water in the collector at a temperature above the sensing point into the hot water storage tank. The sale price of this temperature control device is 150 yuan, which is 70 yuan lower than the price of the original fixed temperature water outlet controller.

3. Application of gravitational heat pipe in solar hot water heater (authored by Yao Maohong [1202 5399 3163], Wang Ronghua [3769 2837 5478] and Chen Jiaying [7115 0163 5391]).

This report is a general introduction to a planar heat pipe solar powered hot water heater and its construction, heat transfer mechanism, whole-day thermal efficiency and cost analysis. Performances of a heat pipe collector and an ordinary planar collector are also compared in this report. The heat pipe solar hot water heater consists of planar gravitational heat pipe solar collectors and a supported water storage tank. This type of solar hot water heater is unaffected by freezing and can operate between -70°C and +70°C. It is immune to atmospheric pollution and corrosion and has a high whole-day thermal efficiency. Compared to other solar collectors of equal output power, it requires less surface area.

4. Study of modular solar drying box (authored by Yao Maohong [1202 5399 3163], Wang Ronghua [3769 2837 5478] and Chen Jiaying [7115 0163 5391]).

This report describes the performance, advantages and disadvantages of stepped plate collector, double flow perforated plate collector and layered metallic mesh collector. The structure, thermal property, drying efficiency, cost analysis, and applicable range of a modular solar drying box are studied. The body structure of this drying box is that of a passive solar house. The five faces are connected with cotter type hinges and can be dissembled in transportation and assembled at the site. An air collector with 1.5 square meters of collecting area is also installed on the south wall to blow hot air into the box. An air displacement natural convection drying system is used and requires no external energy source. The outer cases of the drying box and the air collector are made of rectangular timber splints and fiberboards. The inner and outer surfaces are painted with 2608 and 191 resin to prevent rainwater damage and warping. The volume of the drying box is 3-4 cubic meters.

9698
CSO: 4006/159

## Growth in Beijing

Beijing GUANGMING RIBAO in Chinese 3 Nov 81 p 2

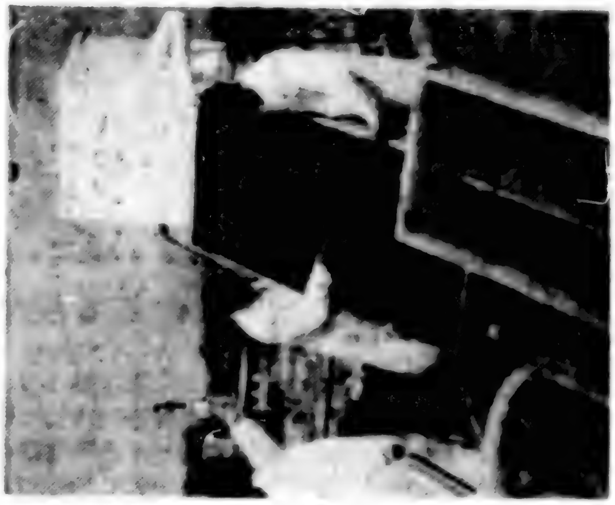
[Text] In the last few years, solar powered hot water heater has had fast development in Beijing. There is a variety of models and the total light collecting area has reached 50,000 square meters, close to one half of the total light collecting area in China. Each square meter can provide 100 kilograms of 40-60°C hot water per day. If they are used 6-7 months out of the year, each square meter will save 200-300 kilograms of coal.

Photograph captions (see page 103 for photos):

(1) Solar hot water heaters installed on the new dormitory building of the Ministry of Foreign Trade by Beijing Municipal Architecture Design Institute and Beijing Municipal Solar Energy Institute have received good comments from their users.

(2) Rotating parabolic focusing type hot water heater developed jointly by Beijing Institute of Control Engineering and Beijing Daxing County Science Committee.

(3) The 300-square-meter solar hot water heater installed at the moving and storage company of Xinhua Bookstore provides bath water for almost 1000 employees in 3 units.



9698
CSO: 4006/115

## Solar Bath House

Shijiazhuang HEBEI RIBAO in Chinese 24 Oct 81 p 1

[Text] Beizhongma Commune in Zhao County has built a large-scale solar energy bath house and put it into operation. The bath house is equipped with dressing rooms, showers and tubs and is capable of accommodating more than 100 persons. In the past, the commune members had to go to the county seat, a round trip of more than 100 li, if they wanted to take a hot bath. Now they do not have to leave the village in order to enjoy a hot bath. The picture shows the external view of the new bath house.

[Photo by reporter Li Yuzhang [2621 3768 4545]

9113
CSO: 4006/114

## China's Largest Wind-powered Generator

Taiyuan SHANXI RIBAO in Chinese 5 Nov 81 p 3

[Text] China's largest wind-powered generator--the 20-kilowatt Model FD17 wind-powered generator--was recently developed by the Heilongjiang Institute of Mechanical Engineering. This wind-powered generator is equipped with an automatic speed governor system. It can be used in extremely cold areas and provides a new solution for electric supply to people living and working in remote rural and pastoral areas.

[Photo by Fan Huichen [5400 1920 3819], correspondent of XINHUA News Agency]

## The FD17 Wind-powered Generator

Taiyuan SHANXI RIBAO in Chinese 7 Nov 81 p 4

[Text] After almost 2 years of testing, China's largest (20 kilowatt) wind-powered generator will soon be transported to the Hulun Buir grassland to be installed and used. The wind-powered generating set measures 14 meters tall and consists of tower frame, platform, revolve, wind wheel, governor, gear box, locking mechanism, generator, direction control and electric control system.

When the wind speed is greater than 3.5 meters per second, the wind wheel can be started to generate electricity. It is capable of normal operation even in the extreme cold of -50°C. According to the wind energy resource data from the Hulun Buir grassland, this generator can produce 30,000 to 50,000 kilowatt-hours of electricity per year and can satisfy the electric needs in rice processing, wheat grinding, sheep shearing, dairy processing and daily lighting of a medium-sized commune.

[Shown here with different tower and blade configuration]

9698
CSO: 4006/193

## Experimental Windmills Generate Power

Beijing XIANDAIHUA [MODERNIZATION] Vol 3, No 12, 16 Dec 81 pp 12-13

[Article by Wang Yetao (3769 0673 3325), Department of Electrical Engineering, Qinghua University: "Another Upsurge in Generating Electricity From Wind Power"]

[Excerpt] According to preliminary calculations, China's wind power reserves are close to 1 billion kilowatts, or 20 times the power generation capacity of the entire world. Given the world's present energy crisis, the development and use of this enormous source of power to generate electricity should be our top priority.

Chinese designed and developed experimental wind-powered generators have been installed on Lishan Island, Zhejiang Province, and near the Badaling wind-powered generator experimental station in Beijing. The 6-meter-diameter vertical blades generate 4-6 kilowatts by means of an asynchronous motor.

CSO: 4006/212

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## Electricity for Lhasa Through Geothermal Resources

Shanghai JIEFANG RIBAO in Chinese 25 Dec 81 p 1

[Article: "Yesterday Evening the Yangbajain Power Station Fed Electricity to Lhasa"]

[Text] This country's first power station using geothermal steam for generation, Lhasa's Yangbajain Experimental Geothermal Station, began to supply electricity to Lhasa yesterday (24 December). The "glorious geothermal station" has added a new energy resource to the ancient city on the snowbound plateau.

The Tibetan plateau lacks coal and petroleum, and in all the agricultural villages and grazing areas the main fuel for the people's production and daily life is cow manure and turf. Many industrial enterprises in the cities rely primarily on wood. Recently, Comrade Hu Yaobang pointed out to the comrades in Xizang, "Solving the energy problem is a top priority matter in fundamentally imroving Xizang's economic situation." Geological prospecting data indicate that Xizang is particularly well endowed with geothermal, hydroelectric, solar and wind energy resources. Of these, geothermal resources are particularly rich: hot springs have already been discovered in more than 600 locations and the area is one of the country's main high-temperature geothermal regions with energy production capability, so that there is extensive potential for development.

The Yangbajain geothermal power station is located in a mountain-enclosed valley 90 kilometers west of Lhasa where the geothermal field has an area of 15 square kilometers and is located 100-200 meters below the surface. The heat reservoir temperature is as high as 170°C or more. When viewed from a distance, the field is covered by a hot mist, and occasionally mushroom-like puffs of steam arise from it. Since 1975, scientists and technicians from all parts of the country have carried out geological exploration work here, have drilled 26 steam wells and have gained experience and worked out techniques in drilling and investigation of high-temperature geothermal wells. The first 1000-kW generator unit was completed in October 1977, and this November a second generator unit with a capacity of 3,000 kW was also completed. The high-voltage transmission line from Yangbajain to Lhasa has also been completed. The geothermal station will improve the Lhasa area's electrical supply and impart new vitality to the national industries and the people's daily lives here.

Installation of the third generating unit is now proceeding at an intense pace.

8480
CSO: 4006/229

## Tianjin Taps Underground Hot Water

Beijing XINHUA in English 0237 GMT 18 Nov 81

[Text] Tianjin, 28 Nov (XINHUA)--In China's quest for energy, a reserve of 192 hundred million cubic meters of underground thermal water over 700 square kilometers has been initially explored in Tianjin, a north China industrial base.

Experts say it can last 192 years at a drilling rate of one hundred million cubic meters of water per year if it is properly pumped back into the subterranean layers.

A total of 391 such wells have been opened up, of which 259 are in use. The water is between 60-96 degrees centigrade in the deep layers and 30-53 degrees centigrade in the shallower ones.

In 1979 alone, the city has drilled 48 million tons of hot water for industrial, agricultural and welfare purposes.

The Tianjin woolen fabrics mill uses 50-degree water in its finishing, bleaching and dyeing processes, which means a saving of 2,780 tons of coal and 18,000 kW. The hot water is being also used in the papermaking, timber, chemical and food industries.

The Tianjin guesthouse makes use of 42-degree hot water for bathing and central heating. The Tianjin No. 4 foodstuff factory and the Tianjin Club are using it for similar purposes.

Zhangdaokou production brigade on the outskirts of the city uses the hot water to irrigate vegetables in its hot houses. Its annual output value amounts to well over 10,000 yuan. Plans are being made to grow mushrooms and flowers.

## Briefs

SOLAR ENERGY SPACE HEATING--Use of solar energy for heating of high-rise units has been successfully tried in Shijiazhuang. A number of solar homes which utilize solar energy for heating have been successfully built in China. There are 15 such homes today. These homes are so-called passive solar homes which use the building itself as the solar energy collector and for storage. Since the first small-scale experimental home was successfully constructed in Minqin Xian, Gansu Province, in 1977, the same principle has been widely applied to buildings including residential houses and office buildings. The series of solar homes were built in a number of areas, including metropolitan areas such as Beijing, Tianjin and Shengyang and in villages and grazing grounds of autonomous districts in a number of provinces such as Gansu, Qinghai and Tibet. In December last year, the city of Shijiazhuang successfully experimented with the solar energy heating of high-rise units consisting of five-story residential buildings. This achievement is significant not only in view of energy conservation and urban pollution abatement but also in improving the quality of people's lives. [Text] [Shijiazhuang HEBEI RIBAO in Chinese 24 Oct 81 p 3] 9113

SOLAR ENERGY WATER HEATER--According to data gathered by the China Solar Energy Society, there are more than 100,000 square meters of solar energy water heaters being used in China today; each square meter of such heaters is capable of saving 200-300 jins of coal a year. A conference was held in Hangzhou in early October by this society. According to their data, Daxing County in the suburbs of Beijing is the site where China's first demonstration new energy village is located. Countywide, the solar energy water heaters which have already been built can provide hot bath water for 15,000 persons every day. More than 130 member families of Liuminying Brigade in this county have built their own solar energy bathrooms. The "sun city"--Lhasa--on the Tibetan plateau has solar energy water heaters of more than 1,000 square meters in total area, providing hot water for both bathrooms and barber shops. The science commission of the autonomous district has further developed a type of portable water heater which is capable of boiling 10 pounds of water in 40 minutes. This unit can be carried to the field or used by families living on grazing land. Today, there are more than 30 plants in 15 provinces and cities in China manufacturing various types of solar energy water heaters with an annual yield reaching 50,000 square meters. A number of different types of simple closed type [menshaishi 1899 2488 1709] household solar energy water heaters have been successfully developed and manufactured in recent years in a number of areas, including Shanghai, Beijing, Hebei and Henan. [Text] [Shijiazhuang HEBEI RIBAO in Chinese 24 Oct 81 p 3] 9113

SOLAR ENERGY OVENS--Utilization of solar energy ovens has fast become one of the new ways of combatting the fuel shortage problem in the rural villages in China. In the remote villages and grazing grounds of the Huabei and Xibei areas, the solar energy oven is affectionately called "convenience oven" or "treasure oven" and is often included as part of the dowry of a bride. According to statistics of the China Solar Energy Society, there are more than 10,000 solar energy ovens being used in villages today all over China. The commune members who utilize these solar energy ovens are widely distributed over more than 20 provinces, cities and autonomoud districts. The popular solar energy oven is present in three types: the box type, the focusing type and the solar boilers. The focusing type solar oven is most suitable for cooking purposes and so is most popular in villages. [Text] [Shijiazhuang HEBEI RIBAO in Chinese 24 Oct 81 p 3] 9113

CSO: 4006/114

## PEAT FORMATION, DISTRIBUTION IN CHINA SURVEYED

Beijing DILI XUEBAO [ACTA GEOGRAPHICA SINICA] in Chinese Vol 36, No 3, 1981 pp 237-252

[Article by Chai Xiu [2693 1485], Peat Bog Research Laboratory, Department of Geography, Dongbei Normal University: "A Preliminary Investigation of the Formation and Patterns of Distribution of Peat in China"*]

[Text] Peat consists of fully or partly decomposed organic debris (primarily plant debris) accumulated over long periods. Peat currently accumulating in bogs is called "exposed peat," and the areas are present-day peat bogs; but if the bog has already disappeared and the peat has become buried, it is called "buried peat."

Peat has a wide range of uses and is a valuable natural energy resource. This article, written on the basis of many years' investigation by classes in the subject and by the author's laboratory, presents a preliminary synthesis and analysis of the data; corrections are invited.

### I. Conditions of Peat Formation in This Country

The formation and accumulation of peat result from a combination of natural factors, particularly moisture and temperature conditions, because moisture and heat not only determine the type and the amount of growth of plants, but also govern the degree of decomposition after the plants have died. The main factors affecting moisture and heat are climate, geology, topography and regional hydrologic characteristics, and an analysis based on these factors and present-day world peat distribution patterns indicates that the regions most favorable to a formation and accumulation of peat are frigid and temperate zones, wet temperate areas and tropical rain forests. But among individual regions, areas of recent structural movement and slow subsidence, areas affected by Quaternary glaciation, areas of permafrost or subsurface water overflow, and areas of change in seacoasts, rivers and lakes all produce bogs and are excellent areas for peat accumulation.

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*Comrades Zu Wenchen and Wang Guizhi provided assistance during the writing of this article, Comrades Gao Fengqi, Lang Huiqing, Li Zhen, Zong Jinyue, Zhang Zeyou, Jin Shuren, Chen Shuyun and Li Handing made useful comments in the manuscript stage, and Comrades Sun Lihua and Tan Chunying prepared the figures; the author takes this opportunity to express his thanks.

Most of this country's peat was formed since the Holocene. Because of our country's great extent and the great variety of natural conditions, there have been considerable variations in the peat formation conditions in various areas over time.

On the national scale, the only areas which have had peat bogs continuously for the last 10,000 years are the northeastern frigid and temperate zones, the moist area of the middle temporate zone, and the moist-to-arid high-altitude frigid zones of the Qinghai-Tibet Plateau and the northwestern mountainous regions. These regions' common feature which is favorable to the development of peat bogs is a warm or cold, moist climate, sufficient water from melting of ice and snow, a long period of soil freezing or a permafrost layer, extensive Quaternary glacial topography, and a dissected and weak land surface with poor drainage. Thus the climatic fluctuations throughout the Holocene resulted in some variability in the intensity of peat accumulation.

The areas which have had conditions unfavor to peat formation since the Holocene are the northwestern arid zone, the loess plateau, cold deserts above 5,000 meters, and high mountain valleys.

In the remaining large area, with the exception of isolated locations which have present-day peat bogs, in the area between 1 and 30 meters below the surface there is generally a 1- to 3-meter stratum of buried peat or rotted wood, indicating that in the past this extensive area frequently had an environment favorable to the formation of peat. Geological data for the Quarternary and peat pollen and analysis indicate a situation as described below.

The early Holocene ($Q_4^1$, 10,000 to 7,500 years ago) was a period when warming began following the most recent ice age (the Tali glaciation), with worldwide encroachment by the seas. In North China the average annual temperature was 2-3° lower than at present and the humidity was greater. The advance of the seas brought most of the North China plain and the coastal area with an elevation of 10 meters or less under water, and there was some flooding of valleys on the southeastern coast, resulting in a warm, moist coastal climate, decreased erosion capabilities of the rivers, and a rise in the water table, producing favorable conditions for peat formation in the coastal regions of the time.

The middle Holocene ($Q_4^2$, 7,500 to 2,500 years ago) was a period of worldwide warming in which the average temperature was 2-3° higher than at present; the lower Yellow River valley was warm and humid, with the temperature increasing southward, producing the most favorable peat formation period in for the whole region. But by 5,000 years ago, north China's climate began to be colder and drier, and a retreat of the seas began; the sea level fell by about 2-5 meters in the northern part of the country and even more in the south, while at the same time the large rivers began to carry large quantities of silt, which accumulated rapidly, so that the river mouths continuously moved outward, forming an extensive coastal plain, and creating excellent conditions for the development of bogs and the accumulation of peat. But there were great changes in the courses of the Yellow River and the Huai, their silt content increased and alluviation proceeded rapidly, so that the central Yellow River-Huai River plain lacked stable peat formation conditions. This was the peak period of peat formation and accumulation in most of the other areas. In the late Holocene ($Q_4^3$, 2,500 years ago up to the present) there were a good many climatic fluctuations; 2,000 years ago north China's climate was still rather warm and moist, while 1,500 years ago it became colder and drier, until by the Southern Song Dynasty the average temperature of the middle and lower Yangtze valley was 1-2° lower than at present and the Suzhou-Hangzhou area had ice and snow in winter, creating favorable peat formation conditions; but the cold and dryness of north China were not favorable for peat formation. Because of abnormal recent structural movements on the southeastern coast, the sea level rose considerably, and the climate was generally as it is today, so that favorable peat formation conditions were lacking. Only in the low coastal plain were there some areas with favorable conditions.

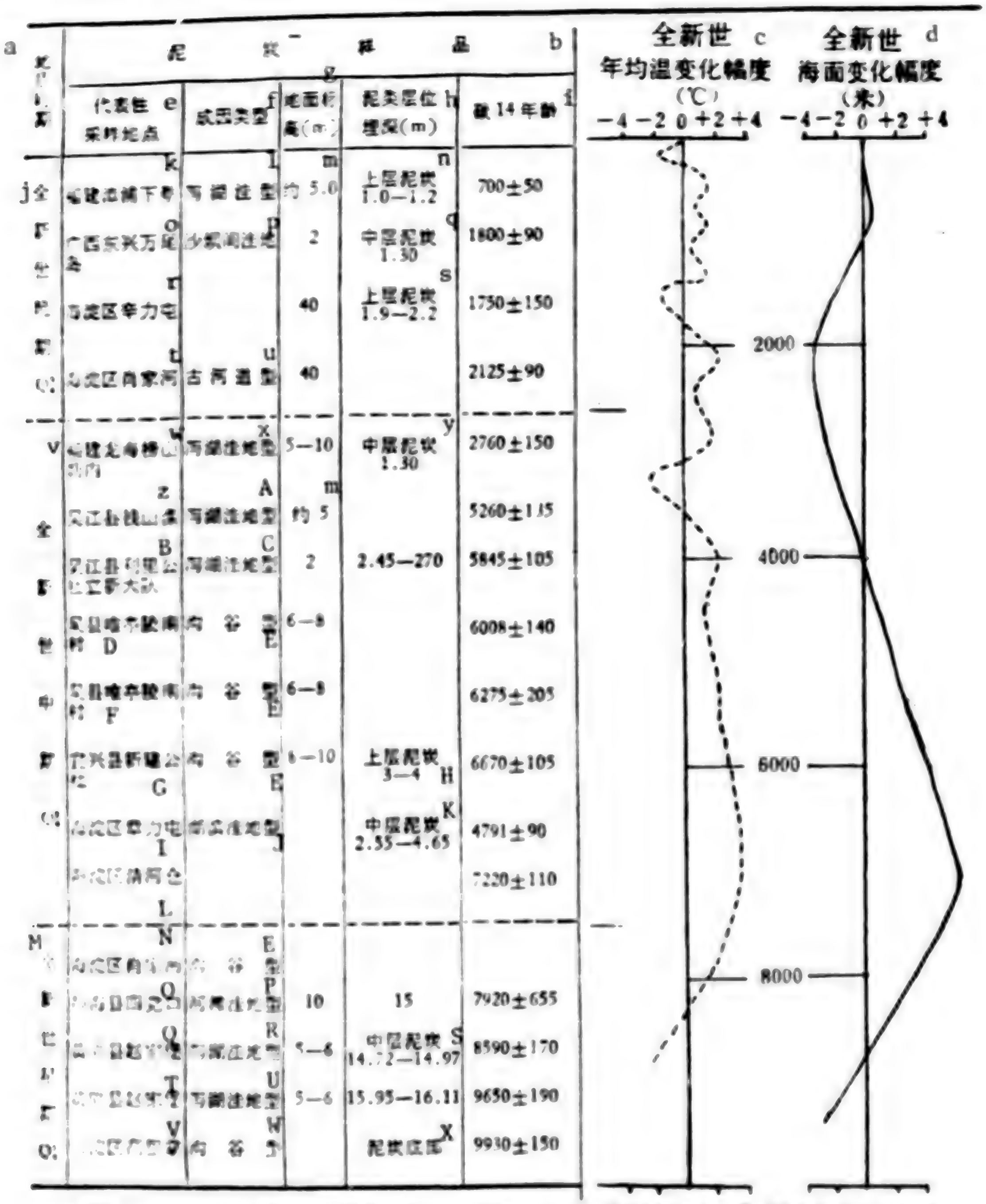

Fig. 1. Ancient Climate in Coastal Regions of This Country

[Key on following page]

[Key for Fig. 1 on p 112]

a. Geologic period
b. Peat samples
c. Annual range of temperature change worldwide
d. Annual change of sea level world wide
e. Representative sample site
f. Determining factor
g. Surface elevation
h. Depth of occurrence of peat stratum
i. Carbon-14 age
j. Late Holocene
k. Xiaji, Zhangpu, Fujian
l. Lagoon flooding area
m. Approximately
n. Upper level peat
o. Wanweidao, Dongxing, Guangxi
p. Flooding area between sand bars
q. Mid level peat
r. Xinlidun, beach area
s. Upper level peat
t. Xiaojiahe, beach area
u. Ancient river course
v. Bangshantang, Longhai, Fujian
x. Lagoon flooding area
y. Middle level peat
z. Qianshanyang, Wujiang
A. Lagoon flooding area
B. Lisi Brigade, Lili Commune, Wujiang County
C. Lagoon flooding area
D. Lingnancun, Weiting, Wu County
E. Gully type
F. Lingnancun, Weiting, Wu County
G. Xinjian Commune, Yixing County
H. Upper level peat
I. Zhanglicun, beach area
J. Lake shore flooding area
K. Middle level peat
L. Lunying, Qinghe, beach area
M. Early Holocene
N. Xiaojiahe, beach area
O. Sitangkou, Jinghai
P. River shore flooding area
Q. Zhaojiabao, Huanghua County
R. Lagoon flooding type
S. Middle level peat
T. Zhaojiabao, Huanghua
U. Lagoon flooding area
V. Gaolizhang, beach area
W. Gully type
X. Lower section of peat

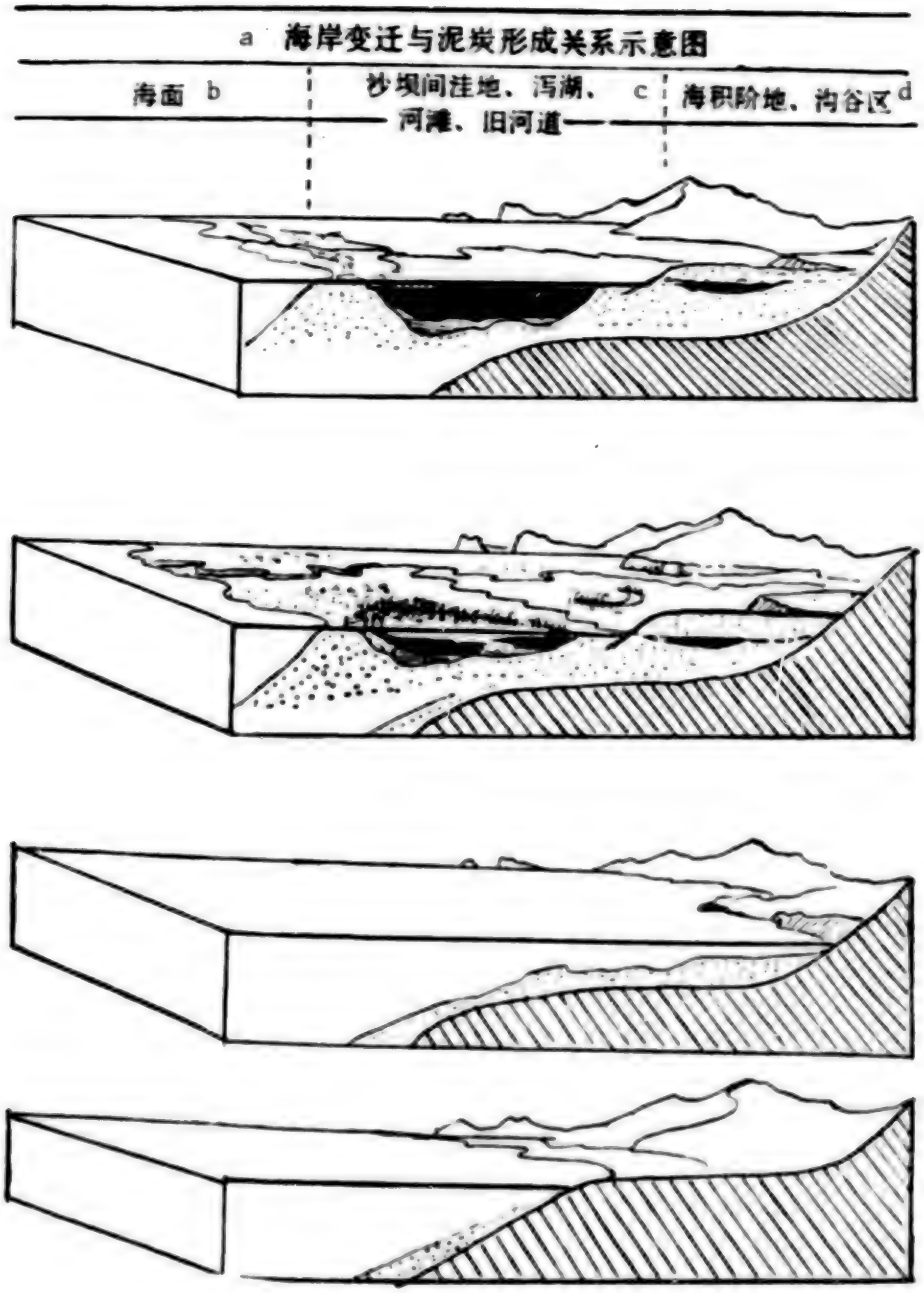

Fig. 1a.

Key:
a. Relationship between seashore movement and peat formation
b. Surface of ocean
c. Flooding area between sand bars, lagoons, river banks, old river courses
d. Marine terraces, gully region

## II. Types and Characteristics of Peat in this Country

Because of differences in the environment of peat formation and differences in the stage of development and the period of its formation, there are great differences in the types and characteristics of peat. Accordingly, establishing a scientific peat classification system is important from a practical as well as a theoretical standpoint.

## A. Categorization of Peats

A wide variety of peat classification systems, based on different scientific criteria and different practical aims, have been established by scientists in this country and abroad. The first classification is generally based on the stage of development of peat, classifying it as low-moor, middle-moor (transitional) or high-moor peat.

The main basis for this analysis is that if the surface is low and level during peat formation and there are numerous watercourses, low-moor peat is formed, while if there is uplifting during the process and water comes from precipitation, the result is high-moor peat; the intermediate type is middle-moor peat. The basis for analysis is ash content, pH and vegetation types. The next stage of classification is based on the main type of plant detritus forming the peat; the peat types are named in terms of the predominant type of plant detritus. Peats containing more than 50 percent of one plant family have simple names, while those that contain less than 50 percent but more than 30 percent of one family are given a compound name. The third classification level should be based on the degree of decomposition of the peat, because this reflects changes in the accumulation environment and the degree of change in the nature and characteristics of the peat under biochemical influences. Accordingly, these peats are classified as highly decomposed (degree of decomposition greater than 40 percent), moderately decomposed (degree of decomposition 20-40 percent), and slightly decomposed (degree of decomposition less than 20 percent).

On the basis of the above principles and analyses and of available peat samples from throughout the country, this country's peat is classified into three large categories and 14 types (see Table 1); each type is also divided into highly decomposed, moderately decomposed and slightly decomposed.

Table 1.

| Type | Variety |
|---|---|
| Low-moor peat | Carex peat |
| | Phragmitex peat |
| | Carex-phragmitex peat |
| | Cobrisia-carex peat |
| | Carex-glyceria peat |
| | Alnus-carex peat |
| | Salix-carex peat |
| | Larix-carex peat |
| Middle-moor peat | Carex-sphagnum peat |
| | Larix-carex-sphagnum peat |
| | Cowberry-sphagnum peat |
| | Larix-ledum-sphagnum peat |
| High-moor peat | Ledum-sphagnum peat |
| | Sphagnum peat |

## B. Characteristics of the Different Types of Peat

1. Low-moor peat (nutrient-rich peat) bogs occur widely in our country, cover a large area and contain large quantities of peat; many large peat pits are in this category. Carex peats are the most numerous type, followed by carex-phragmitex and phragmitex peats, while cobrizia-carex and carex-glyceria peats occur primarily in high-altitude cold regions such as the Qinghai-Tibet Plateau; the other types occur mostly in mountain valleys.

The main types of plant detritus in peats of this family include primarily Creax, but also Phragmitex communis, Cobrizia, Equisetum, Glycerium, Menianthes triolata and Deyeuxia among the herbaceous plants; tree and shrub detritus includes Larix, Pinus, Betula, Abies, Salix, Alnus and the like.

Low-moor peat in this country has a rather high ash content and a rather low organic matter content. The ash content is highest in buried peat. The crude ash content of exposed peat is generally 25-40 percent and the net ash content 6-15 percent; the crude ash content of buried peat generally is over 35 percent and even as high as 60 percent, while the net ash content is low. Because of differences in the time and place of formation, there are marked differences in ash and nutrient composition. For example, calcium (CaO) and iron ($Fe_2O_3$) are extremely variable, in the Lesser and Greater Xingan Mountains and the Changbai Mountains, owing to extensive occurrence of granite and basalt there is little calcium, only about 1 percent, and iron content is only about 2 percent; but in semiarid areas or those with large quantities of limestone, the calcium and iron content is very high. For example, in peat from the Ruoergai region the calcium content is as high as 5 percent or even 10 percent, while iron content ranges from 7 to 12 percent; obviously the lithology and water supply in these regions have an indirect relevance. In addition, because peats from most of the eastern plain were formed relatively long ago, the low-moor peats in particular frequently have ash contents higher than 45 percent.

The degree of decomposition is generally proportional to the ash content. Peats from cold, moist areas of the northeast have a relatively low ash content and are only slightly decomposed, while intermediate or highly decomposed peats have the highest ash content. High-ash peats from areas with relatively high temperatures and insufficient moisture are mostly peats with a high or medium degree of decomposition. The degree of decomposition is also correlated with the nature of the plant detritus in the peat; under given natural conditions, some plant detritus decomposes easily while other types decompose slowly. For example, stalks of Menyanthes triolata may be 75 percent decomposed within a year, while Stachys aspera may be only 5 to 10 percent decomposed. Because low-moor peat in our country has relatively high ash content and a high degree of decomposition, the water content is rather low, generally only 70-80 percent, while the water content of buried peat is generally less than 40 percent. The pH is frequently neutral or slightly acidic, but it may be basic in a few cases.

The humic acid content is usually 20-30 percent, while some peats in an intermediate stage of decomposition have a higher carbon content, up to 30-40 percent. Because buried peats or peats from arid regions have a high ash content and a high degree of decomposition, the humic acid content is rather low, generally below 20 percent.

In addition, the degree of decomposition is very closely related to the composition of the detritus; for example, when woody detritus is more frequent, humic acid content may exceed 50 percent, while in mossy peats it may be less than 20 percent.

2. High-moor peats (nutrient-poor peats) occur sparsely in our country, cover a small area and account for small reserves, but they do occur in some high-altitude, cold, moist mountain regions. The only types that have been discovered thus far are sphagnum peat and ledum-sphagnum peat. High-moor peat bogs are atypical in our country. The high-moor peat bogs in the Greater and Lesser Xing'an mountains and the Changbai Mountains do not show marked surface convexity, and the peat layers are rather thin, not exceeding 2.5 meters and mostly less than 1 meter, and in some cases the peat has not gone through a low-moor stage, but has formed directly into high-moor peat in permafrost soil; this type of peat is rather common in the A'ershan and I'ersi regions in the Greater Xing'an Mountains.

The main plant detritus occurring in high-moor peat in this country is sphagnum, followed by Podytrichium, while tree detritus includes Larix and shrubs include Ledum and Vaccinium. There are as also some herb residues such as Carex and small quantities of Gossypium cyperaceae[?]. High-moor peat has a high organic content, generally 80-90 percent or more, and a very low ash content. For the most part it is only slightly decomposed, generally not more than 20 percent, and the water content is high, generally 80-90 percent. It is usually acidic, with a pH of 3.5-5.5. The humic acid content seldom reaches 15 percent; xanthohumic acids are most numerous, accounting for about half of total humic acids.

3. Middle-moor peat (medium-nutrient or transitional peat) is also uncommon in our country, being limited to cold, moist districts of the northeast; it covers a small area and includes only limited reserves. The most common types are larix-carex-sphagnum peat and latrix-ledum-sphagnum peat, while carex-sphagnum and larix-ledum-sphagnum types are also fairly common. The other characteristics of this type of peat are transitional in nature.

An idealized presentation of the characteristics of these peat types is given in Table 2.

Table 2. Idealized characteristics of samples of Chinese peat types

| 泥炭类型 a | | 分解度% b | 有机质% c | 粗灰分% d | 纯灰分% e | 营养成分% f | | | 灰分成分% g | | | 腐植酸% h | | | pH | 饱含水量% i | 采样地点 j | 地貌部位 k |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 类 o | 种 p | | | | | 全N | P₂O₅ | K₂O | CaO | Fe₂O₃ | MgO | 总量 l | 黑腐 m | 棕腐 n | | | | |
| 低位泥炭 q | 苔草-芦苇 r | 15-20 | 69.16 | 30.84 | 9.06 | 1.70 | 0.29 | 0.61 | 0.62 | 1.45 | | 36.82 | | — | 5.5 | 40.11 | 吉林辉南金川 s | 熔岩台地(平) t |
| | 木贼-苔草 u | 15-20 | 72.45 | 27.55 | 8.85 | 2.19 | 0.36 | 0.26 | 1.09 | 1.47 | — | 46.27 | | — | 5.3 | 42.02 | 吉林抚松兴隆 v | 熔岩台地(平) w |
| | 苔草 x | 20-30 | •60.92 | 39.08 | 6.20 | 2.02 | 0.05 | — | 5.12 | 7.51 | — | 33.58 | 28.04 | 5.54 | 7.8 | 35.34 | 四川若尔盖多玛 y | 宽谷(平) z |
| | 苔草-芦苇 A | 25-35 | 35.85 | 64.15 | 12.89 | 1.62 | 0.13 | 1.63 | 2.60 | 4.60 | — | 33.11 | — | — | 5.8 | 20.79 | 内蒙科右后旗 B | 阶地后缘(平) C |
| | 苔草 D | 35-40 | 60.66 | 39.35 | 7.48 | 0.89 | 0.13 | 0.09 | 1.00 | 0.56 | 0.08 | 35.65 | 28.24 | 7.44 | 5.9 | 33.17 | 广西桂北 E | 沟谷(平) F |
| | 苔草 G | 40-45 | 71.31 | 28.69 | 6.05 | 0.91 | 0.07 | 0.07 | 0.20 | 0.56 | 0.09 | 50.49 | — | — | 5.5 | 41.36 | 广东下[illegible] H | 沟谷(平) I |
| | 苔草 J | 35-40 | 65.05 | 34.95 | 7.34 | 1.86 | 0.26 | 1.26 | 0.83 | 2.28 | 1.23 | 32.45 | 21.47 | 11.63 | 6.1 | 37.73 | 辽宁清原 K | 河漫滩地(平) L |
| 高位泥炭 M | 杜香-泥炭藓 N | 10-15 | 88.67 | 11.42 | 4.36 | 1.61 | 0.15 | 0.14 | 0.78 | 1.24 | 0.21 | 23.05 | 9.55 | 14.54 | 4.3 | 51.43 | 黑龙江伊春林场 O | 河漫滩地(平) P |
| | 泥炭藓 Q | 10-15 | 87.53 | 12.47 | 3.68 | 1.01 | 0.21 | 0.15 | 0.61 | 0.31 | 0.20 | 19.70 | 5.38 | 14.21 | 4.2 | 50.77 | 内蒙古阿尔山 R | 熔岩台地(平) S |
| 中位泥炭 T | 苔草-泥炭藓 U | 15-20 | 70.19 | 25.89 | 5.73 | 1.85 | 0.34 | 0.30 | 1.19 | 2.70 | 0.24 | 32.73 | 21.09 | 11.48 | 5.0 | 40.70 | 吉林敦化黄泥河子 V | 河漫滩地(平) W |
| | 落叶松-苔草-泥炭藓 X | 15-20 | 61.51 | 37.19 | 5.54 | 1.82 | 0.35 | 0.32 | 1.01 | 1.58 | — | 30.00 | 19.81 | 11.33 | 4.7 | 35.67 | 吉林抚松松江河 Y | 阶地后缘(平) Z |

[Key on following page]

[Key to Table 2 on p 118]

| | |
|---|---|
| a. | Peat type |
| b. | Degree of decomposition |
| c. | Organic matter |
| d. | Crude ash content |
| e. | Net ash content |
| f. | Nutrients |
| g. | Ash content |
| h. | Humic acids |
| i. | Carbon content |
| j. | Sample location |
| k. | Terrain location |
| l. | Total |
| m. | Melanohumic acid |
| n. | Xanthohumic acid |
| o. | Type |
| p. | Variety |
| q. | Low-moor peat |
| r. | Carex-phragmitex |
| s. | Jinchuan, Huinan, Jilin |
| t. | Lake basin flooding area (exposed |
| u. | Alnus-carex |
| v. | Xinglong, Fusong, Jilin |
| w. | Lava tableland (exposed) |
| x. | Carex |
| y. | Weqili, Ruoergai, Sichuan |
| z. | Broad valley (exposed) |
| A. | Carex-phragmitex |
| B. | Duotaobuhao, Nei Monggol |
| C. | Rear edge of terrace (buried) |
| D. | Carex |
| E. | Pubei, Guangxi |
| F. | Gully (buried) |
| G. | Carex |
| H. | Zhenzhuwan (Pearl Bay), Xialu, Guangdong |
| I. | Gully (buried) |
| J. | Carex |
| K. | Qinyuan, Liaoning |
| L. | River bank flooding area (buried) |
| M. | High-moor peat |
| N. | Ledum-sphagnum |
| O. | Hongqi Forest Area, Heilongjiang |
| P. | River bank flooding area (exposed) |
| Q. | Sphagnum |
| R. | Aershan, Nei Monggol |
| S. | Lava tableland (exposed) |
| T. | Middle-moor peat |
| U. | Carex-sphagnum |
| V. | Huangnihezi, Dunhua, Jilin |
| W. | River bank flooding area (exposed) |
| X. | Larix-carex-sphagnum |
| Y. | Songhuajiang, Fusong, Jilin |
| Z. | Rear edge of terrace |

## III. Distribution and Regional Classification of Peat in This Country

### A. Overall Distribution and Classification into Regions

Peat is very unevenly distributed over the country, generally occurring more in the north than in the south and being less common with increasing distance from the sea. Exposed peat generally occurs in mountains and plateaus, especially in the northern part of the northeast and the mountain and hill areas of the east, and in the Three Rivers plain. These areas account for more than half of the country's total peat resources; behind them comes the Qinghai-Tibet Plateau, accounting for 19 percent of the country's peat reserves. Buried peat occurs extensively in the eastern alluvial plain, accounting for about 11 percent of peat reserves. There are only a few other peat areas, and peat occurs only sporadically in them. Analyses and estimates based on incomplete data indicate that the total peat area nationwide is about 4.159 million hectares, or 0.43 percent of the total surface area of the country. Total peat reserves are estimated as 27.02 billion tons (air-dried weight) with exposed peat accounting for 80 percent and buried peat for 20 percent of the total.

Six peat distribution regions can be distinguished on the basis of the primary peat formation factors; each of these regions can be divided into subregions in terms of certain natural features and the abundance of the peat (see Fig. 2).

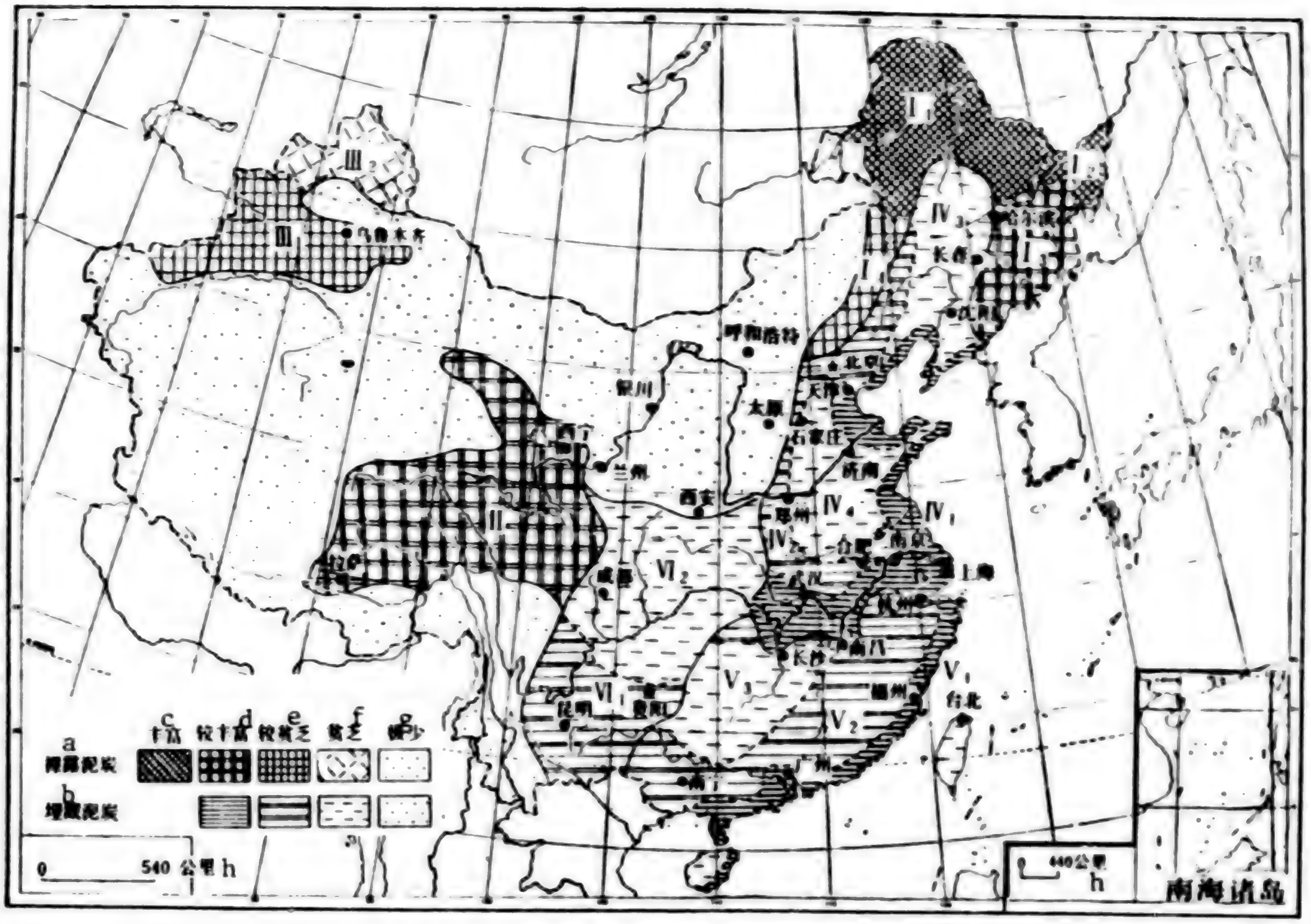

Fig. 2. China's peat regions

Key:

| | | | | | |
|---|---|---|---|---|---|
| a. | Exposed peat | d. | Fairly abundant | g. | Extremely uncommon |
| b. | Buried peat | e. | Relatively sparse | h. | Kilometers |
| c. | Abundant | f. | Sparse | j. | South sea islands |

I. Northeastern cold moist zone, middle temperate zone exposed peat region
$I_1$. Abundant peat region of Greater and Lesser Xing'an Mountains
$I_2$. Abundant peat region of Three Rivers Plain
$I_3$. Relatively abundant peat region of Changbai Mountains
$I_4$. Relatively scarce peat region of eastern edge of Inner Mongolian plateau
II. Qinghai-Tibet plateau semimoist high-altitude cold climate exposed peat region
III. Exposed peat region of the moist-arid high altitude cold northern border mountains
$III_1$ Relatively sparse peat region of Tianshan Mountains and foothills
$III_2$ Sparse peat region of Aertai Range
IV. Eastern alluvial plain buried peat region
$IV_1$. Relatively abundant peat region of the coast and middle and lower Yangtze
$IV_2$. Relatively sparse peat region of Yan and Taihang range foothills
$IV_3$. Sparse peat region of Song-Liao plain
V. Buried peat region of central and south China hills and coastal area
$V_1$. Relatively abundant peat region of southeast coast
$V_2$. Relatively sparse region of southeastern hills
$V_3$. Sparse peat region of south China mountains.
VI. Southwestern plateau and basin buried peat area
$VI_1$. Relatively rich peat area of Yunnan and Guizhou plateaus
$VI_2$. Sparse peat area of Sichuan Basin

At present there is great variation in the amount of investigation that has been carried out on the various peat regions, and hard exploration data are also limited. Using various types of data, consideration of natural factors, and analysis and rough computations on 100,000:1 and 200,000:1 maps, we have made rough estimates of the peat reserves in the various peat regions, as shown in Table 3.

Table 3. Area and reserves of peat in various regions

| 分布区 a | 分布面积（万公顷） b | | | 储量（亿吨） c | | |
|---|---|---|---|---|---|---|
| | 裸露 d | 埋藏 e | 合计 f | 裸露 g | 埋藏 h | 合计 i |
| I | 214.0 | 3.1 | 217.1 | 153.2 | 2.5 | 155.7 |
| II | 94.0 | — | 94.0 | 51.0 | — | 51.7 |
| III | 36.0 | 1.5 | 37.5 | 11.3 | 0.5 | 11.8 |
| IV | 0.9 | 38.0 | 38.9 | 0.5 | 29.8 | 30.3 |
| V | 0.7 | 9.2 | 9.9 | 0.3 | 6.5 | 6.8 |
| VI | 2.1 | 16.4 | 18.5 | 1.2 | 13.4 | 14.6 |
| j 总计 | 347.7 | 68.2 | 415.9 | 217.5 | 52.7 | 270.2 |

Key:

a. Region
b. Area of occurrence (10,000 hectares)
c. Reserve (100 million tons)
d. Exposed
e. Buried
f. Total
g. Exposed
h. Buried
i. Total
j. Total

B. Characteristics of Peat from the Various Regions

1. The northeastern cold moist zone and middle temperate zone exposed peat region. This region is located mostly between north latitudes 42° and 53° and includes the Greater and Lesser Xing'an Ranges, the Changbai Range and their piedmont areas and the Three Rivers plain, as well as the eastern edge of the Inner Mongolian plain, and is the part of the country with the greatest occurrence of peat bogs and the richest quantities of exposed peat (see Fig. 3).

a. One of the favorable conditions for peat formation is the climate. This area has a long period of low temperatures and a high humidity, with an average air temperature in the warmest month of only 18-22°C, a cumulative activity temperature ($\geqslant 10$°C) of about 1700-3000°C, an annual precipitation of 400-900 mm, and, with the exception of the eastern edge of the inner Mongolian Plain, a moisture coefficient exceeding 1; generally the freeze period is 200-300 days. Most of the area also has insular permafrost. As a result, the soil is cold and moist, with poor aeration characteristics, so that biochemical processes are greatly inhibited and decomposition capabilities are very weak; plant detritus is likely to be preserved, and peat bogs occur extensively. But because of the limited growth of vegetation, peat accumulation is slow and the peat strata are generally rather thin.

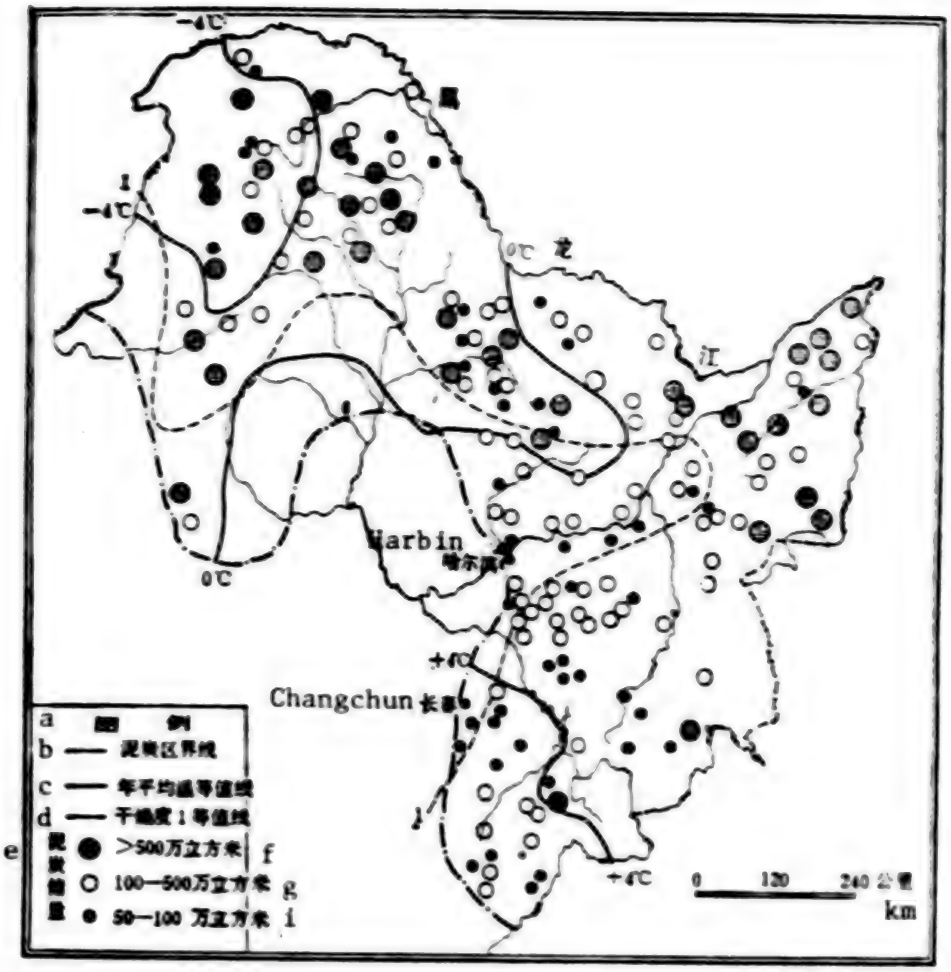

Fig. 3. Peat distribution in northeastern moist frigid and moderately frigid region

Key:

| | | | |
|---|---|---|---|
| a. | Legend | e. | Peat reserves |
| b. | Boundaries of peat areas | f. | More than 5 million cubic meters |
| c. | Annual average temperature contours | g. | 1-5 million cubic meters |
| d. | Contour for aridity value of 1 | i. | 0.5-1 million cubic meters |

Second, the geology and topography are favorable to peat formation. Recent structural movements are not much in evidence throughout the area, the land surface is dissected and weak, valleys are broad and there are many depressions, the watersheds slope gently, and there are many lava tablelands. The land surface has poor drainage capabilities, the subsurface water table is relatively high, providing an excellent environment for peat formation, particularly in the Three Rivers Plain, and since the Tertiary period it has been slowly subsiding, so that the elevation is only 40-60 meters and the surface inclination is only 1:1,000 or 1:10,000, there are many flooding areas within river meanders, and strata impermeable to water lie close to the surface, so that water drainage is very difficult and there are long-standing surface water accumulations over large areas. The eastern edge of the

Inner Mongolian plain is a gently rolling high plain where sandhills and sand dunes have already become fixed and depressions between them and river valleys are extremely broad. Not only is the subsurface water level high, but there are many warm springs. Under the combined influence of cold, moisture and permafrost, peat bogs continue to develop, although the peat layers are very thin.

b. The distribution patterns for peat depend on the natural conditions and the characteristics of peat show regular changes from north to south. The first of these is the degree of covering,* which generally decreases in a southward direction, while the thickness of the peat shows the opposite tendency, increasing from north to south. Peat quantities are clearly larger in the north than in the south, and medium-moor and high-moor peat are also more abundant in the north. In mountain regions there are also vertical changes. For example, because the land is at a rather high altitude in the Changbai Mountains, three major zones can be distinguished: the first, below 500 meters, has predominantly low-moor carex peat and carex-sedge peat; the zone between 500 and 1,000 meters commonly has cowberry-Gossypium cyperaceae [?] - sphagnum peat with small areas of alnux-carex peat and scrub birch - carex peat; between 1,000 and 1,800 meters there occur larix-ledum-sphagnum peat, larix-Gossypium cyperaceae [?]-sphagnum peat and small quantities of ledum-sphagnum peat. The Lesser and Greater Xing'an mountains are not so high, and the vertical changes are not so pronounced, with the exception that sphagnum peat occurs sporadically at the feet of north-facing slopes at about 1,000 meters in the Greater Xing'an Range.

Moreover, in river valleys peat occurs more frequently on tributaries than on the main river and is more prevalent in the upper and middle reaches. For example, peat is relatively abundant on the Muomin, Keluo and Namoer Rivers, which are tributaries of the Nen River, on the middle and upper reaches of the Huifa River, a tributary of the Songhua River, on the middle and upper reaches of the Danmu River, on the Erdaobai River, the Lalin River and the Tangwang River, and or the upper reaches of the Hun River and Tumen River, tributaries of the Yalu River. However, the Three Rivers plain is a special case.

c. Sources of peat. The main tendency throughout the area is conversion of grassy marshland to bogs, and secondarily the conversion of water bodies and forest slash areas to bogs. In mountainous and hill areas bogs frequently develop in depressions, lava tablelands, volcanic crater lakes, flat watersheds and gentle slopes; in the plains and valleys, they occur frequently on riverbank flooding areas, old river courses, oxbow lakes and flooding areas on lake shores as well as the back edges of terraces. For example, the peat bog in the vicinity of the Hongqi Forest Area on the Tangwang River in the Lesser Xing'an Mountains is the result of conversion of a marshy riverbank grassland and water bodies into bog (see Fig. 4). The peat bog began with an oxbox lake, afterwards expanding to the entire river shore, and has now developed to the medium and high moor stage. In the Changbai Mountains many enclosed lakes and extinct volcanic crater lakes on the lava tableland have gradually evolved into peat bogs, such as a thick peat bog in an area of large meadows and flatlands west of Jinchuan Commune, Huinan County, which resulted from such an evolution of ponds.

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*Degree of covering: the degree to which a unit ground area is covered by peat (720 cm thick); expressed as a percentage.

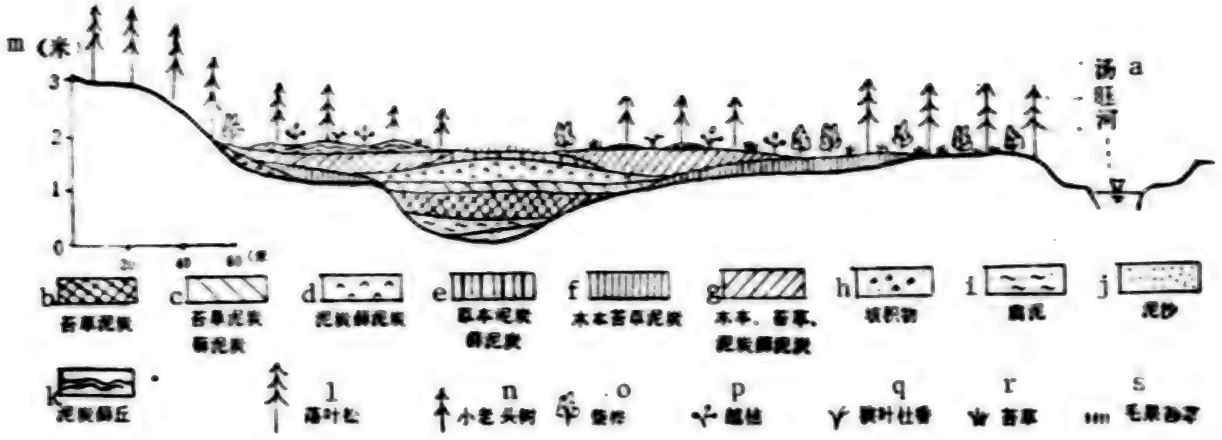

Fig. 4. Cross section of river bank peat bog in Hongqi Forest Area, Lesser Xing'an Mountains

Key:

| | | | |
|---|---|---|---|
| a. | Tangwang River | j. | Silty sand |
| b. | Carex peat | k. | Sphagnum hummocks |
| c. | Carex-sphagnum peat | l. | Larix |
| d. | Sphagnum peat | m. | meters |
| e. | Herbaceous-sphagnum peat | n. | small laotou [5071 7333] |
| f. | Woody-carex peat | o. | scrub birch |
| g. | Woody-carex-sphagnum peat | p. | Cowberry |
| h. | Slope wash | q. | Narrowleaf ledum |
| i. | Sapropel | r. | Carex |
| | | s. | Pilocarpus hepaticae [?] |

d. Compared with peat areas throughout the world, this area has a small degree of covering and the occurrence of peat is sporadic. High-moor peat bogs do not occur extensively, primarily because of the relatively low temperature and humidity of this rea; in addition there are few plains, and the surface relief is considerable and was not acted upon by Quarternary continental glaciation (see Table 4).

2. The Qinghai-Tibetan Plateau moist-arid high-altitude cold-climate exposed peat region. This region primarily comprises the eastern part of the Qinghai-Tibet Plateau and its peat largely occurs in tablelands, basins and broad valleys at altitudes between 3,200 and 4,500 meters, with very little peat occurring above the latter altitude.

a. Factors favorable to peat formation. Because of the high elevations, the climate is cold and relatively moist, with an average annual temperature of -1.9 to -4°C and an average temperature in July of less than 12°C. The cumulative activity temperature ($\geqslant 10^\circ$C) generally does not exceed 1,000°C, the average annual precipitation is 300-800 mm, and the moisture coefficient is 1-2. Although the air temperature is low, the amount of solar radiation is rather large (annual solar) radiation 120-150 kcal/m$^2$). Accordingly, vegetation grows rather lushly. Because of the availability of water from melting ice and snow and the occurrence of permafrost, the surface layer is cold and has excess moisture, and there may even be standing water, which greatly weakens the effect of biochemical processes and inhibits decomposition of detritus, thus favoring long-term development of peat bogs.

Table 4. Comparison of peat in China with worldwide occurrence areas

| 项目 a<br>b 地区 | 纬度 c (北纬) | 地貌 d | | 气候 e | | 主要泥炭类型 f | 泥炭厚度(m) g | | 平均泥炭覆盖度 (%) h |
|---|---|---|---|---|---|---|---|---|---|
| | | 类型 i | 海拔高(m) j | 年均温 (℃) k | 湿润系数 l | | 平均厚 m | 最厚 n | |
| o 兴安岭 | 47—53° | 低山丘陵 v | 200—1,000 | −4—0 | ≥1.0 | 低位苔草泥炭 | 0.5—1.5 | 3 | 4 |
| q 长白山地 | 41—46° | 中山丘陵 w | 200—2,000 | 0—4 | 1.0—1.5 | p 低位苔草泥炭 | 1—2 | 9 | 2 |
| r 北美东北部 | 42—55° | 高平原 x | 200—500 | 8—10 | 1.0—1.5 | 高位藓类泥炭 s | 2—5 | 10 | 5 |
| t 北欧 | 50—65° | 平原 y | 10—150 | 4—10 | 1.0—2.0 | u 高位藓类泥炭 | 3—6 | 20 | 8 |

Key:

| | | | |
|---|---|---|---|
| a. | Item | n. | Maximum thickness |
| b. | Area | o. | Xing'an Range |
| c. | Latitude (N) | p. | Low-moor carex peat |
| d. | Terrain | q. | Changbai range |
| e. | Climate | r. | Northeastern North America |
| f. | Main peat type | s. | High-moor moss peats |
| g. | Peat thickness | t. | Northern Europe |
| h. | Average peat cover rate | u. | High-moor moss peats |
| i. | Type | v. | Low mountains and hills |
| j. | Elevation | w. | Medium mountains and hills |
| k. | Average annual temperature | x. | High plain |
| l. | Moisture index | y. | Plain |
| m. | Average thickness | | |

In addition, there are rather many tablelands and depressions, and extensive Quarternary glacial terrain; valleys within the tablelands are broad, without much surface relief, and ponds and flooding areas are frequent; drainage is poor, creating excellent conditions for the formation and accumulation of peat.

B. In general, the amount of peat decreases with increasing altitude (between 3,000 and 5,000 meters) and increasing latitude, and generally occurs in rather large tablelands and broad valleys.

The peat occurring on tablelands is located particularly in the northwestern corner of the Qinghai-Tibet Plateau, in the Ruoergai Tableland (elevation 3,400-3,600 meters); this is the world's largest tableland peat bog. Peat covers almost the entire valley floor, terraces and lakeshores, and different peat bogs formed in the area have coalesced to form an extremely large, complex bog (see Fig. 5) Because the thick peat strata have leveled out the valley floor, an extremely broad valley became a valley with underground streams or no streams. Peat strata are generally 2-3 meters thick but may be as thick as 10 meters. The area's peat bogs amount to nearly 300,000 hectares and the peat reserve is more than 2 billion tons, all of which is low-moor carex peat and cobresia-carex peat of relatively uniform type. In addition, the area where the Yellow River originates, e.g. Xingsu Lake and the shores of Jialing and Eling Lakes, as well as the northern shores of

Qinghai Lake and the eastern part of the Tsaidam Depression, also have peat bogs, but because of the high latitude and elevation, the temperatures are even lower and the areas is rather arid, so that the peat bogs are not as extensive in as in Ruoergai tableland.

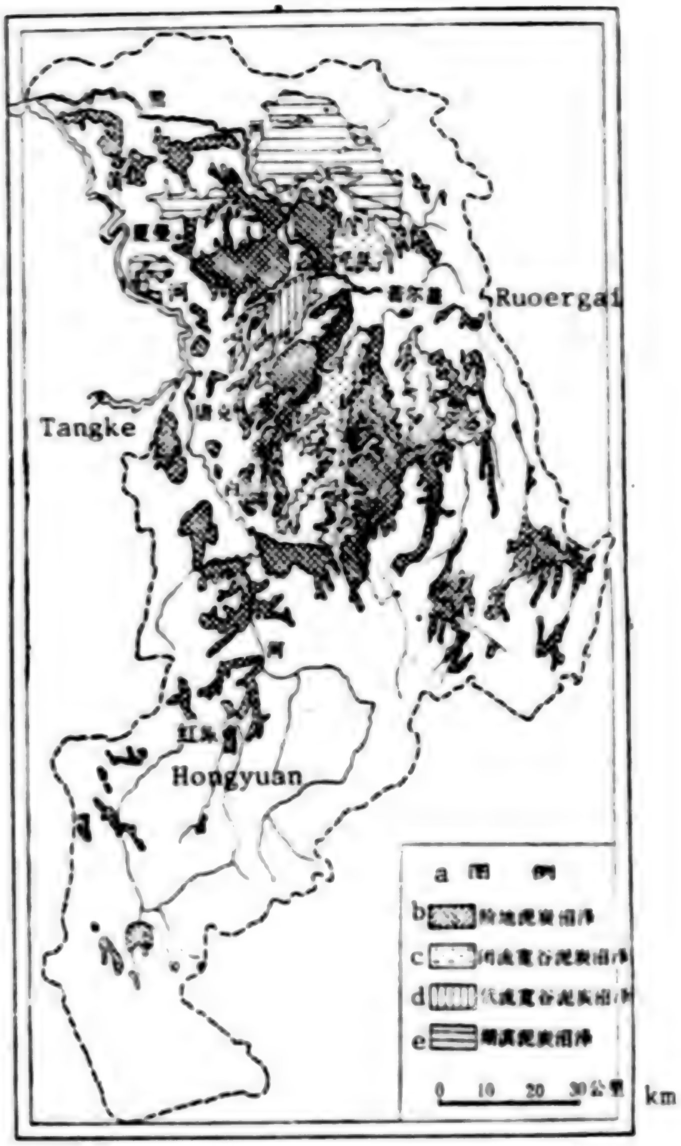

Fig. 5. Peat bog types in Ruoergan high plain

Key:
a. Legend
b. Terrace peat bogs
c. Peat bogs of broad valleys with enclosed rivers
d. Peat bogs of broad valleys with subterranean streams
e. Lake shore peat bogs

The main areas of extensive broad-valley peat accumulations are the area behind the Potala and the Yangbajing area on the upper reaches of the Lhasa River; most of the valley floors have a peat cover, which in these two places covers nearly 10,000 hectares. The peat is 1-2 meters thick, and in some places as much as 6 meters thick. Large peat bogs occur on the shore and low terraces of the Yalucangbu River in the section where its valley is broad; in the Dangxiong and Naqu area of northern Tibet there is 66,000 hectares of peat in the Naqu area, but because of the high altitude and the low temperature, the peat is thin, generally only about 0.5 meters thick. In addition there are sporadic peat bogs along the Tongtian River and the upper reaches of the Datong River in the Qilian Mountains. There are also thin peat bogs in the icy lakes at 4,500 meters in southern Tibet.

3. The exposed peat region of the moist-arid high altitude cold northern border mountains. This region includes the Tianshan and the Aertai mountains and foothills. The alpine climate is cold and moist with large quantities of water from the melting of snow and ice, extensive Quarternary glacial topography, broad valleys, pluvial-alluvial fans in the foothills, and upwelling of underground water, so that peat bogs have been able to develop. But because the Aertai Range area is cold and dry, peat is uncommon. In this region the peat occurs primarily in three zones.

a. Broad river valleys and basins among the mountains (elevations of 2,000-3,600 meters). Peat bogs occur extensively in the Greater and Lesser Youerduosi River basin on the upper reaches of the Kaidu River, in the Tekes River basin on the upper reaches of the Ili River and on the banks and terraces of the Kongnaisi River basin, generally with thicknesses of 1 to 2 meters. In addition, there is some peat on flat watersheds, e.g. at Dabancheng on the upper reaches of the Baiyang River and at Houxia on the upper reaches of the Urumchi River. Carex peat and cobrisia-carex peat are the most common..

b. Peat occurs in flooding areas at the edge of alluvial-pluvial fans; for instance, the area from Siluoshu to Qitai on the north slopes of the Tian Shan show intermittent thin peat bogs.

c. Peat occurs on lake shores and flooding areas along rivers; for example, thin peat bogs occur at the mouth of the Kaidu River, the outlet of the Kongque River and flood lands along the Tarim River.

4. The eastern alluvial plain buried peat region. This regions begins in the north at the Song-Liao Plain and continues south to the middle and lower reaches of the Yangtze river; it is the richest buried peat area in the country. Coastal peat was produced mainly by movements of the shoreline, while on the middle and lower reaches of the Yangtze it was produced by changes in rivers and lakes, and in low-lying areas on the piedmont by emergence of subsurface water and changes in river courses. A preliminary estimate puts the amount of peat in the area at 3.03 billion cubic meters, but its distribution is very irregular, with large occurrences along the coast and in the middle and lower reaches of the Yangtze; there is less peat in flooding areas at the intersection of mountain and plain areas, while it is relatively uncommon on the Sung-Liao Plain and extremely uncommon on the Yellow River-Huai Plain.

a. Distribution and characteristics of buried peat on the coast and in the middle and lower reaches of the Yangtze. Buried peat is fairly abundant along the coast from the mouth of the Yalu to Hangzhou Bay, occurring on the coastal plain at elevations below 5 meters, while two strata generally occur at the bottoms of short river valleys which enter the sea directly (elevations generally about 10 meters). The first type occurs extensively south of Lianyun Bay buried rather shallowly in thin strata; it is mined over a large area and was formed at a relatively late date (much of it from the middle Holocene on). On the Yangtze delta, much of the peat occurs under cultivated land at elevations of 5 meters or less, being most common in the area around Taihu Lake, with small occurrences in stream valleys at about 10 meters elevation; in 18 counties in Zhenjiang and Suzhou Prefectures, 290 peat deposits have been found, totaling 550 million cubic meters. In addition, sporadic buried peat has been found in Qingpu and Songjiang Counties in Shanghai City and in Shangyu, Cixi and Yuyao counties on the shore of Hangzhou Bay. It also occurs on the bottom of Changyang Lake, Dianshan Lake and Baima Lake, on the Shandong and Liaodong peninsulas and on the coastal southeastern slopes of Yan Mountains, where owing to the closeness of the mountains and hills to the sea, the peat is often buried in coastal stream beds at 10-15 meters above sea level; it is rather deeply buried and in rather thick strata, but occurs sporadically and over a small area, for example, in more than 20 counties in Linyi and Yantai Prefectures, in six counties in Tangshan Prefecture, and in the area from Dandong to Pulandian; the total accumulation does not exceed 50 million cubic meters. In the Yellow River, Hai River and Liao River deltas it occurs over a broad area, but because of rapid alluviation, the long-standing dry climate, and salination and alkalinity of the soil, it is relatively uncommon and is buried rather deeply.

Since ancient times both banks of the main stream of the Yangtze in its middle and lower course, including the shores of Dongting and Poyang Lakes, where there have been considerable changes in the shorelines, have been regions with extensive marshes, and it has now been discovered that there are two or three buried peat strata below the surface, primarily along the flood land on both sides of the river, the old rivercourse and the lake shore, where rush peat and rush-moss peat predominate and where the detritus contains rather large quantities of calamus and water chestnut seeds and tree detritus, as well as shells.

b. Distribution and characteristics of buried peat in the Yanshan and Taihang Mountains and low-lying land in their piedmont areas. In this area, peat occurs primarily in river valleys, low-lying parts of alluvial-pluvial fans, old river courses and back edges of terraces. For example, there are large quantities of buried peat in the Qian'an, Yanqing, Zunhua and Xuanhua basins in Hebei; there are 22 peat pits in the Qian'an basin alone. Between Beiqicun and Wendun in Baoding, there are two peat strata buried in the old river course, while in the Sanquan peat pit at Beiyunmen, Huinan County, Hunan there is a typical fan margin peat deposit.

Carex-phragmitex peat predominates throughout the area, with calamus occurring rather abundantly in the detritus, along with some tree detritus and rotted wood and small quantities of moss detritus.

c. Buried peat distribution and characteristics on the Song-Liao Plain and the Yellow-River-Huai Plain. In this broad plain, small quantities of buried peat occur only in the old river course, on lake shores, in river flood areas, on back edges of terraces and in low-lying land between the rivers.

It is generally buried quite deep, and the minables deposits are small and scattered. There are a few minable deposits on the Song-Liao Plain, with a volume of 1.5-2.7 million cubic meters. The peat type is extremely uniform, with the vast majority being carex-phragmitex peat of very poor quality, containing much mud and sand and with a high ash content. The characteristics of the various areas are detailed in Table 5.

5. The buried peat region of the central and south China hills and coastal areas. Since the Holocene, this region has always had a semitropical and a tropical zone. The surface is considerably dissected, but the mountains are steep, which is not favorable to peat formation; however, the changes in the coastline have provided a favorable environment for peat formation, so that peat is relatively abundant on the coast and becomes less common with increasing distance from the coast.

a. Distribution characteristics of coastal peat. The northern section, from Hangzhou Day to the Pearl River delta, including Taiwan, is currently a coastal subsidence region; the coastline is tortuous and the coastal region narrow, with little peat except in short valleys. In the southern section, from the Pearl River delta to the mouth of the Beilun River, including Hainan Island, the coastal region is rather broad, there are extensive deltas, and the marine terraces are also broad, with the first-level terrace occurring at 5-10 meters above sea level and the second at 15-25 meters above sea leve; peat occurs primarily in these two terraces.

Buried peat in alternating sandbars and depressions and lagoons. Such areas as the eastern coast of Haikang and Xuwen Counties on the Leizhou Peninsula, and the coastal region of Dianbai, Wuchuan and Yangjiang counties, all have two or three sand bars running parallel to the coastline, with considerable peat buried on the lee sides of areas where sandbars alternate with depressions, at a depth of about a meter; the part covered by the sandbar is rather deeply buried, and the thickness is about 0.5-1.0 meters. This peat generally was formed rather late.

Drowned valley-type buried peats are the thickest peat strata in this region and the deposits with the largest peat reserves; deposits of this type resulted when small coastal river valleys or avines resulting from the dissection of marine erosion-deposition terraces became drowned valleys as the level of the sea rose following the ice age, then were blocked by sand bars and became lagoons, gradually developing into bogs. These formed thick strata of peat, and following the retreat of the sea, the bogs declined and were invaded by trees and shrubs; when, after a long period, the sea level again rose, the wooded areas were also converted into bogs and the trees died and formed a 2-3 meter layer of rotting wood, on which peat accumulated; this cycle was repeated, forming alternating strata of peat and rotted wood. The thick peat deposits in Pearl Bay, Daoqi County, Guangdong were formed in this way (see Fig. 6); the river bottoms on the second marine terrace have 1-3 peat strata buried 1-2 meters below the paddies and separated by 1-3 layers of rotted wood; the peat layers average 1-2 meters thick, with a maximum thickness of 20 meters, and the rotted wood strata are also 2-4 meters thick.

Table 5. Characteristics of eastern alluvial plain buried peat region

| 项目 a \ b 地区 |  | c 沿海地区 |  | d 长江中下游 | e 燕山、太行山山前地区 | f 松辽平原 | g 黄淮平原 |
|---|---|---|---|---|---|---|---|
|  |  | 渤海沿岸 h | 黄海沿岸 i |  |  |  |  |
| 区域范围 j |  | 鸭绿江口至连云港 k | 连云港至杭州湾沿岸 l | 宜昌至镇江长江平原（包括湖泊）m | 包括山间小盆地 n | 包括部分山前台地 o | 包括山东丘陵 p |
| 地貌特征 q | 类型 r | 沟谷海湾 s | 滨海低平原 t | 河湖洼地 u | 洪积-冲积平原 v | 冲积-湖积平原 w | 冲积平原 x |
|  | 标高 (M) y | 5-15 | 3—10 | 8—15 | 10—50 | 50—100 | 10—50 |
| 主要泥炭成因类型 z |  | 沟谷河漫滩洼地型 A | 河湖、河漫滩洼地型 B | 河漫滩洼地、旧河道、湖泊型 C | 扇缘洼地、旧河道、沟谷型 D | 河漫滩洼地沟谷与湖泊型 E | 湖泊型河间洼地型 F |
| 泥炭类型 G |  | 苔草、苔草-芦苇泥炭 H | 苔草-芦苇泥炭 I | 苔草-芦苇泥炭、芦苇泥炭 J | 芦苇泥炭、苔草-芦苇泥炭 K | 芦苇泥炭苔草泥炭 L | 芦苇泥炭苔草-芦苇泥炭 M |
| 泥炭埋深(米) N | 最深 O | 6.0 8.0 | 3.0—5.0 | 4.0 | 8.0 | 3.0 | 10.0 |
|  | 平均 P | 1.0—2.0 | 0.5—1.0 | 1.0—2.0 | 1.0—2.0 | 1.0—2.0 | 2.0—3.0 |
| 泥炭厚度(米) Q | 最厚 O | 3.0—4.0 | 2.0—3.0 | 2.0—2.5 | 4.0—5.0 | 2.0—3.0 | 2.0 |
|  | 平均 P | 0.5—1.5 | 0.2—0.8 | 0.2—1.0 | 1.0—2.0 | 1.0—1.5 | 0.2—1.0 |
| 较大泥炭矿点数 R | 50—100万 S | 1 |  | 11 | 8 | 6 | 1 |
|  | 100—500万 T | 4 | 59 | 8 | 12 | 7 | 3 |
|  | >500万 U |  | 8 | 2 |  | 2 |  |

[Key on following page]

[Key to Table 5 on p 130]

a. Item
b. Area
c. Coastal area
d. Middle and lower Yangtze
e. Yan and Taihang Range foothills
f. Song-liao plain
g. Yellow River-Huai Plan
h. Bohai coast
i. Yellow Sea coast
j. Type of district
k. Mouth of Yalu to Lianyun Bay
l. Lianyun Bay to south shore of Hangzhou Bay
m. Yichang to Zhenjiang River (including two lakes)
n. Including small basins and mountains
o. Including some piedmont tablelands
p. Including Shandong hills
q. Terrain characteristics
r. Type
s. Gully bay
t. Low beach plain
u. River bank and lake shore
v. Diluvial-alluvial plain
w. Alluvial-lacustrine plain
x. Erosion plain
y. Elevation
z. Main peat formation factors
A. Gully, river bank flooding area
B. Lagoon, river bank flooding area
C. River bank flooding area, old river course, lake
D. Fan margin flooding area, old river course, gully
E. River bank flooding area, gully and lake
F. Lake, interfluvial flooding area
G. Peat categories
H. Carex, carex-phragmitex
I. Carex-phragmitex, phragmitex
K. Calamus, carex-phragmitex
L. Phragmitex, carex
M. Phragmitex, carex-phragmitex
N. Depth of peat burial (m)
O. Maximum
P. Average
Q. Peat thickness (m)
R. Number of relatively large peat pits
S. 0.5-1 million
T. 1-5 million
U. Over 5 million

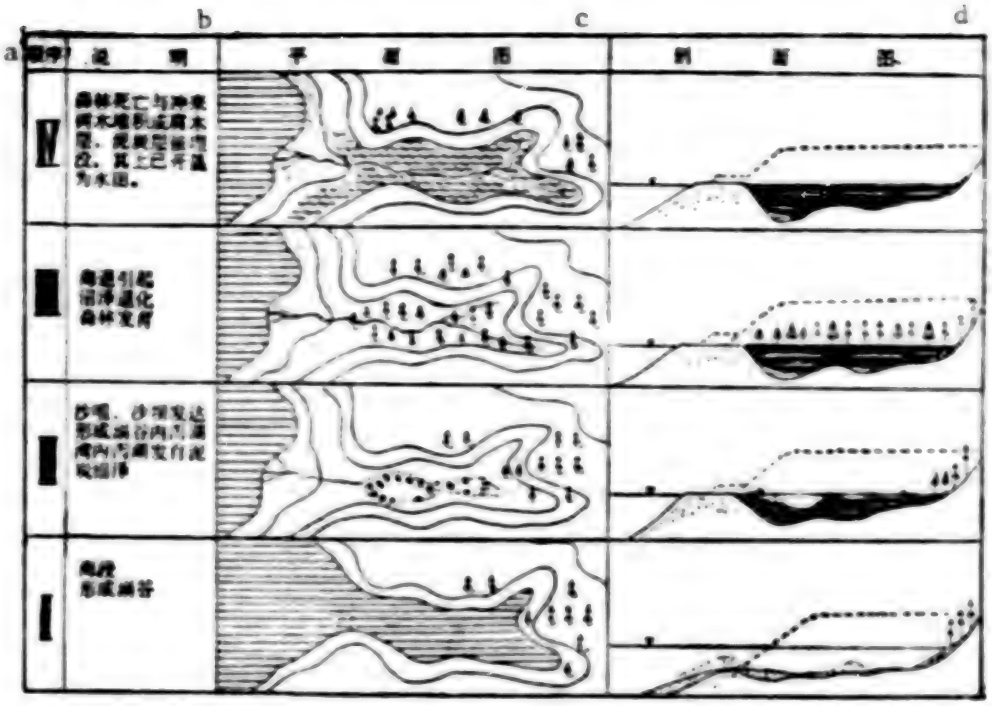

Fig. 6. Process of formation of drowned valley-lagoon type buried peat in Zhenzhu Bay, Suixi County, Guangdong

Key:
a. Sequence
b. Explanation
c. Area map
d. Cross section
I. Invasion by sea forms drowned valley
II. Sandpits, sandbars develop, forming lagoon within drowned valley; peat bogs develop in lagoon
III. Retreat of sea causes decline of bogs, forests develop
IV. Trees die and, with waterborne wood, form rotted wood stratum, peat strata are buried. Land reclaimed as fields

Subsurface erosion pond basin buried peat is a special type which occurs on the second-level marine terraces. The material making up the marine terraces is Beihai and Zhanjiang sand, clay and sandy gravel; when the sea level fell, the terrace surfaces where there was standing water underwent undercutting, and depressions gradually became deeper and larger and developed into nearly round basins; when the sea level rose again and the subsurface water level rose, the subsurface erosion ceased and the basins filled with water and became lakes, then evolved into marshes. When the sea level fell again, the marshes declined and were invaded by forests; when the sea level rose again they were again converted into bogs and the trees died, forming a rotted wood layer. The process was repeated, forming an alternation of peat and rotted wood. The Xiehe Peat Pit in Yanggan Commune, Daoxi County was formed in this way; in addition, the immensely thick peat deposits in Tiaoshu-Wushan and Shanhouyang, Zhanjiang City, and Xialu Quanshui, Suixi County, have the origins and bedding characteristics of both of the types described.

The buried peat of depressions in flooding areas and in old river courses generally was formed rather late. The peat in Shanyang Commune, Yangjiang County, Guangdong Province and that on the low coastal plain in Wenchang County, Hainan Island, are of this type. The Pearl River and Han River deltas both produced peat of this type.

Carex peat predominates in this region, with carex-phragmitex peat of second importance; there are many intervening thick rotted wood layers, and the peat contains rather large amounts of wood detritus.

Mountain and hill peat is of scattered occurrence for the most part and reserves of it are very small; quantities decrease with increasing distance from the sea, and most of it occurs in small basins between mountains, depressions in river flooding areas, and river terraces.

These peat layers are generally rather thin, 0.5 to 1.0 meters thick, with a few measuring 2-3 meters thick and occasional locations having a thickness of 4.5 meters. This peat is predominantly of the carex type, with carex-phragmitex peat being of secondary importance; layers of rotted wood alternate with it. In addition, in relatively high mountain areas, the high altitude and cold, moist climate have resulted in formation of present-day peat bogs in certain small basins between mountains and depressions at the ends of ravines; the Xishan Hills, Nanchang (700-800 meters above sea level) and the Wugong and Xuefeng Mountains in Hunan (1200-1500 meters above sea level) have both carex-sphagnum and sphagnum peat. The altitudes at which it occurs generally increase from east to west.

6. Buried peat of the southwestern plateau and basins. The natural conditions in this region are complex, high mountains, narrow valleys and karst topography are rather common, and the climate is extremely variable. Accordingly, peat is relatively abundant only in the Dianzhong and Qianzhong plateaus. In the Dianzhong plateau in particular, where the ground surface is dissected and weak and the climate is warm and moist, buried peat is quite abundant. It is rare in the other areas.

a. In the Yunnan and Guizhou plateaus, peat is most common in the Yunnan plateau; 108 counties in Yunnan province have been found to have peat, most of it buried and a small portion of it exposed. It is most abundant in the Erhai and Dianchi Lake shore areas and in pingba [1627 8218] (broad, shallow valleys). The peat strata are 0.5 to 1.5 meters thick. The area of next greatest abundance is the Diandong pingba area, where the peat is widely distributed, and buried only 0.15-0.5 meters deep, with the peat strata measuring 1-2 meters thick. Moreover, in the basins of the two semimountainous areas of Zhongxun County in northwest Yunnan, and northeastern Yunnan, because of elevations above 3,000 meters and the cold moist climate, there are extensive peat bogs with peat strata 2-3 meters thick. The western Yunnan plateau, which is also high, cold and moist, has sporadic peat bogs. On the Guizhou plateau, peat occurs primarily in the Qianzhong plateau, for example, there is buried peat on the lake shore and lake bottom. Peat bogs also occur in the mountains, for example, at Leigongping in the Leigong Mountains (1,880 meters above sea level), where sphagnum peat bogs have been discovered. Extensive karst topography makes the rest of the area unfavorable for peat formation.

b. In the Sichuan Basin, peat occurs primarily in the southwestern part and in the mountains; Tuo County, Zhaojue County and Xide County in Sichuan all have buried peat, generally in piedmont depressions and ravines and in river flooding areas. The peat strata are 2-3 meters thick. Zhaojue county is 2,300 meters above sea level, and because of the high altitude, cold and moisture, peat occurs extensively in layers 1-3 meters thick; present-day peat bogs also occur in the Greater and Lesser Liangshan Mountains. With the exception of the high-altitude, cold mountain regions, the whole area has small quantities of sphagnum peat, while the vast majority is low-moor carex peat and carex-phragmitex peat.

8480
CSO: 4006/169

## Briefs

HEILONGJIANG PEAT DEPOSITS--The provincial peat prospecting team recently discovered a 3 million cubic meter peat deposit in Dedu County, Heilongjiang Province. It will be extracted beginning this winter. [Harbin Heilongjiang Provincial Service in Mandarin 1100 GMT 30 Nov 81 SK]

CSO: 4006/207

## POWER GENERATION, TRANSMISSION ADVANCES

### Generating Capacity Increasing

Beijing XINHUA in English 1234 GMT 28 Dec 81

[Text] Beijing, 28 Dec (XINHUA)--Fourteen new big power generating units have been put into operation this year, adding 1.83 million kw to existing power generating capacity, the Ministry of Power Industry announced here today.

Eequipment added in 1981 includes 4,200 kilometers of high-tension transmission lines, one being China's first 500,000-volt ultra-high transmission line running for 600 kilometers between Pingdingshan in Henan Province and Wuhan in Hubei Province, and five million kva of transformers.

The new thermal power generating units include a 125,000 kw unit at the Huangpu Power Plant in Guangdong Province, a 125,000 kw unit at the Shiliquan Power Plant in Shandong, a 200,000 kw unit at the Shentou Power Plant in Shanxi Province, two 100,000 kw generating units at the Mudanjiang No. 2 Power Plant in Heilongjiang Province, a 200,000 kw generating unit at the Fularji Power Plant in Heilongjiang, a 200,000 kw generating unit at the Huaibei Power Plant in Anhui Province, a 75,000 kw generating unit at the Yulijiang Power Plant in Hunan, and a 50,000 kw generating unit at the Baoding Power Plant in Hebei.

The new hydropower generating units include a 210,00 kw generating unit at Wujiangdu in Guizhou, two 170,000 kw generating units at Gezhouba in Hubei, a 150,000 kw generating unit at Panjiakou in Hebei, and a 60,000 kw generating unit at Etan, Guangxi.

The transmission lines and new power generating units have relieved to a certain extent power shortages in Guangdong, the Beijing-Tianjin-Tangshan area, northeast China and central China.

The 200,000 kw generating unit at the Shentou Power Plant has boosted total generating capacity there to 550,000 kw making it the biggest power plant in coal producing Shanxi Province. It is now delivering two million kwh of electricity daily to the Beijing-Tianjin-Tangshan area. The Panjiakou Hydropower Plant shares the peak load in this area.

With completion of the second 210,000 kw generating unit at the Wujiangdu Hydropower Plant the needs of Guizhou Province are met and electricity also goes to Chongqing, Sichuan Province's largest city via the newly built Zunyi-Qijiang 220,000-volt transmission line.

This line and China's first 500,000-volt transmission will deliver electricity from the Gezhouba power station on the Yangtze River to Wuhan, Hubei and parts of Henan Province.

CSO: 4020/68F

## Power Industry Minister

Beijing Domestic Service in Mandarin 1200 GMT 22 Dec 81

[Interview with Li Peng, Minister of Power Industry, Conducted by Station Reporter on 22 December; place not given--recorded]

[Excerpts] [Question] Comrade Li Peng, since the power industry is the lifeblood of the national economy, many of our listeners are very interested in it. Would you please tell us about the situation in the power industry this year?

[Answer] The overall situation in the power industry this year has been good. Progress has been made in implementing the policy of readjustment. It is expected that all state plans for power generation and construction and all technological and economic targets for this year will be fulfilled. As of 20 December, some 296 billion kw of power have been generated. It is expected that some 306 billion kw of power have been generated. It is expected that some 306 billion kw of power will be generated for the entire year, a 2 percent increase over last year.

[Question] Besides the Gezhouba power station, what other power stations have been put in production this year?

[Answer] Since the beginning of this year, besides the No. 1 generating unit of the Gezhouba power station, over a dozen other generating units of hydraulic and thermal power stations have been put in production at (Tanjiakou) in Hebei, Wujiangdu in Guizhou, (Wotan) in Guangxi, Fulaerji and Mudanjiang in Heilongjiang, Huaibei in Anhui and Huangdao and (Siliquan) in Shandong. These stations have generated a total of 1.49 million kw this year. It is estimated that these power stations can add 1.8 million kw per year to the nation's total power output. They have played a significant role in solving acute power shortages in their respective areas. In addition, over 4,000 kilometers of high-tension power transmission lines have been strung and high-voltage transformers with a total capacity of 5 million kw have been installed in the nationwide power network this year.

[Question] What is planned for next year's power production and construction?

[Answer] Premier Zhao Ziyang pointed out in his report on the government work that in power construction and production it is necessary to develop both hydraulic and thermal power by adapting to local conditions, but the emphasis will be gradually shifted to hydraulic power. Both staff and workers in the power industry must resolutely implement this policy. Because of the readjustment of the national economy and the relatively acute fuel shortages, power output next year is not expected to increase by any sizeable margin. The state has planned to increase next year's power output by 2.6 percent over this year. But it is anticipated that power consumption by agriculture, light industry and households next year will surpass the rate of increase in power output. Besides, heavy industrial production will also increase again next year. Therefore, throughout the country, and particularly in coastal areas, the demand for power will be greater next year than this year. In view of this situation, it is most important to implement the policy of paying equal attention to developing energy resources and practicing economy in power consumption and to use power in a well planned and economic way.

The state attaches great importance to power construction. Total investments and loans to the power industry next year will be larger than this year. Some 1.75 million kw of additional power output have been planned for next year and construction of 12 power plants will begin, expand or resume next year. They include both hydraulic and thermal power stations at (Tianshengqiao) on the Hongshui River and in Shanxi's Shouxian County, as well as at Pingdingshan in Henen, Feicheng in Shandong, Chongqing in Sichuan, (Shajiao) in Guangdong and Dawukou in Ningxia.

CSO: 4006/224F

## Transmission Cable Safety

Hefei Anhui Provincial Service in Mandarin 1100 GMT 16 Dec 81

[Text] The Anhui Provincial People's Government recently held a province-wide telephone conference on insuring the safety of power network transmission facilities. Vice Governor Meng Jiaqin addressed the conference.

The conference held that power transmission cables are the arteries for transmitting energy to all industries and trades as well as to every household. Governments at all levels and every department and unit concerned should fully coordinate their efforts and take effective measures to put an end to the bad practice of disrupting power transmission cables in order to insure the safe supply of power. Leading cadres at all levels should make great efforts to insure the safety of power transmission lines as they have successfully insured railway security. They should boldly undertake this task and should educate and mobilize the masses to protect power transmission cables. All units and individuals should strictly implement the rules, regulations, and other related public notices on protecting power transmission cables. Those who have made outstanding contributions in protecting the cables should be commended and awarded; those who have failed to follow regulations should be criticized, and those who steal or disrupt the power lines should be dealt with resolutely.

The conference called on all localities to give top priority to protecting power transmission lines when enlarged in afforestation, construction of water conservancy projects or installing up communications and broadcasting cables. They should all observe the various state regulations.

(Diao Xiusheng), director of the Provincial Power Industry Bureau, and (Han Rong), deputy director of the Provincial Public Security Bureau, aired their opinions on how the public security department of the power industry should insure the safety of power network transmission facilities.

CSO: 4006/168F

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## National Standard for Power Line Fittings

Beijing DIANLI JISHU [ELECTRIC POWER] in Chinese No 11, 5 Nov 81 p 70

[Article by Dong Jie [5516 0679 6166] of the Nanjing Electric Power Fittings Research Institute, Zhang Lizhi [1728 4539 1807] of the Scientific and Technical Information Research Institute of the Ministry of Power: "Brief Introduction to the Establishment of the National Standards for Electrical Power Fittings"]

[Text] I. General Situation of Development

China already has a history of over 30 years of manufacturing fittings for use in power transmission and electric power transformer projects. At the beginning, China only produced spare parts for hanging power lines. Later, production was gradually expanded to all accessories for external installations of power plants and substations and they were generally called electric power fittings. In 1962, the Ministry of Water Conservancy and Power issued the first set of standards (SD002-62 -- 024-62) for fittings entitled "Fittings for Suspended Overhead Power Lines and Substations." It included a total of 22 series and 182 products. In 1963, the ministry compiled a standard of fixed designs for fittings totaling 91 series and 665 products. In 1974, the fixed designs were revised and it adjusted the series to 81 and 463 products. As we built 330- to 350-kilovolt ultrahigh voltage power lines, new conducting lines and insulators continued to emerge, and the varieties of fittings also continued to increase. The original standards issued by the ministry were far from satisfying the need.

After 1974, to adapt to the newly increased varieties and to improve the quality of the products, users' opinions were solicited, and information concerning standards for fittings of foreign nations were gathered and analyzed and experiments and tests in many aspects were carried out. In 1980, the standards issued by the ministry in 1974 were revised again, and the revised standards are awaiting review and approval by the National Bureau of Standards for implementation as a national standard. The new national standard for electric power fittings has a total of 32 times, coded by number from GB2314-80 to 2345-80. The establishment of the standards and related questions are briefly introduced below.

II. Principle of Compilation

According to regulations on the control of standardization in our nation, the establishment or revision of standards must fully consider the demands of use, closely combine with natural conditions, rationally utilize national resources, and the standards must be technically advanced, economical and rational, safe and reliable. Therefore, the standards for fittings manifest the following aspects:

1. The standards are centered around production of fixed types and general purpose products, taking the interchangeability of new and old products into full consideration.

2. The standards coincide with international standards as much as possible to adapt to international interchangeability and exchange.

3. To adapt to the needs of development of the electric power industry, the standards have included new products that have been continuously tested and determined to operate reliably.

4. The series of products of the fittings should be coordinated and should conform to the current national standards for conducting lines and insulators.

III. Content and Scope of Suitability

The scope of the standards includes all fittings for suspended overhead electric power lines and outdoor power distribution installations of substations. There are a total of 5 parts listed below.

1. GB2314-80 to 2317-80 are general purpose technical conditions for fittings, series for standard weighing, damage and load, dimensions for junctions of spare parts, nomenclature for models and types and regulations for inspection and testing methods. They are the basic principles for structural design, selection of materials and the quality of technology.

2. GB2318-80 are line clamps and junction fittings for assembling various types of insulators, including various types of suspension weights, tension tolerant line clamps, hanger rings, hanger boards, connecting plates and U shaped screws and butterfly plates.

3. GB2331-80 to 2335-80 are connecting fittings for various types of conducting lines, including connecting pipes, repair pipes, line fasteners and grooved line clamps.

4. GB2336-80 to 2339-80 are protective fittings for conducting lines and insulators, including various vibration resistant weights, separation rods, pre-wound wires and even pressure shielding rings.

5. GB2340-80 to 2345-80 are junction fittings for conducting lines, conductors and electrical devices, including line clamps for various devices, T-shaped line clamps, copper and aluminum transition plates, bus line flexible nodes and fixed fittings for hard and soft bus bars.

The standards are suitable for power lines and power distribution devices from over 10 kilovolts to 330 kilovolts (some of the fittings are suitable for use for 500 kilovolts). It is suitable for the XP-7 ∼ 30 model suspension type insulator and accessories of (various types) of indoor and outdoor propped insulators. It is also suitable for various types of bare conducting lines (16 to 700 square millimeters), zinc plated wound steel wires (25 to 150 square millimeters) and for coupling with square (below 3,000 amperes) and grooved (below 10,800 amperes) hard bus bars.

The GB2315-80 "series of standard damage load and dimensions for junctions of spare parts" are closely related to the standard series for insulators. The determination of the series of fittings is based on assemblies and systems of single strand and multiple strand insulators selected as in Table 1.

Table 1 Matching Chart for Various Voltage Conducting Lines, Insulators and Fittings

| Voltage (kilovolts) | Conducting Line Cross-section (mm$^2$) | Insulator Series Matching | |
|---|---|---|---|
| | | Suspension | Tension |
| under 110 | under 185 | XP-7 | XP-7 |
| 220 | 240-400 | XP-7 | XP-7 Dual Series |
| 220 | 500 | XP-7<br>XP Dual Series (Dadangju [1129 2909 6415]) | XP-7 Triple Series |
| 330 | 2 (240-400) | XP-16 | XP-16 Dual Series |
| 500 | 4 (300) | XP-16 | XP-21 Dual Series |
| 500 | 4 (400) | XP-16<br>XP-16 Dual Series (Dadangju [1129 2909 6415]) | XP-30 Dual Series |

Because the insulators have already been included in the national standards, the fittings should coincide with the specifications of the insulators, therefore the standard weighing damage load classification in the standards is determined as in Table 2.

Table 2 Bolt Selection Chart for Various Rated Load Levels

| Rated Load Series (tons) | 4 | 7 | 10 | 12 | 16 | 20 | 25 | 30 | 50 | 60 |
|---|---|---|---|---|---|---|---|---|---|---|
| Bolt Selection | M16 | M16 | M18 | M22 | M24 | M27 | M30 | M36 | M42 | M48 |
| Bolt Bore Diameter (mm) | 18 | 18 | 20 | 24 | 26 | 30 | 33 | 39 | 45 | 51 |

9296
CSO: 4006/158

## Briefs

HEILONGJIANG HIGH VOLTAGE LINES--Heilongjiang Province has built seven high voltage power lines and 360,000-kilovolt-ampere transformers in 1981. Five of these high voltage power lines are 425 kilometers long and have a 220,000 volt capacity. These power lines account for 36 percent of the province's total. [Harbin Heilongjiang Provincial Service in Mandarin 1100 GMT 20 Dec 81 HK]

HEILONGJIANG POWER LINE--A 53 km 220,000 volt power line was recently put into operation at the (Hulaerji) second power plant. It is the only power line connecting the Qiqihar, Nenjiang, Daqing and Nei Monggol areas. Installation of the powerline took from the winter of 1979 to 26 November of 1981. [Harbin Heilongjiang Provincial Service in Mandarin 1100 GMT 10 Dec 81 SK]

HEILONGJIANG POWER GENERATOR--The second 100,000-kilowatt generating unit was put into operation on 6 December at the Second Mudanjiang Power Plant in Heilongjiang Province. This generating unit will ease the electricity shortage in the eastern part of the province. (Zhang Kexiao), mayor of Mudanjiang Municipality, cut the ribbon for the opening of this unit. [Harbin Heilongjiang Provincial Service in Mandarin 1100 GMT 6 Dec 81 SK]

SHANDONG POWERPLANT--A large power station will be built at the Longkou powerplant, Shandong Province. The designed capacity of the station is 600,000 kilowatts. The first stage of this construction project will be completed in 1983 and 1984. An inauguration ceremony for this project was held 17 December at the Longkou powerplant. The Deputy Governor of Shandong Province, Song Yimin, attended the ceremony. [Jinan Shandong Provincial Service in Mandarin 2300 GMT 17 Dec 81 SK]

WUHAN POWER TRANSMISSION LINE--Since the beginning of 1981, work has been carried out on a 500,000-volt extra-high voltage power transmission line from Gezhou Dam to Wuhan. The powerful amount of electricity generated by the Dezhou Dam will be transmitted through this line to other places. The Gezhou-Wuhan extra-high voltage power transmission line starts at Bezhou Dam gate and ends at Wuchang's Fenghuangshan Mountain, passing through Yichang, Dangyang, Jiangling, Jingmen, Xianjiang, Mianyang and Wuhan counties. The line spans the Changjiang River twice and has a total length of 338 kilometers. [Wuhan Hubei Provincial Service in Mandarin 1100 GMT 10 Dec 81 HK]

CSO: 4006/202F

HEILONGJIANG TRANSMISSION NETWORK--A 110,000-volt high-tension transmission line to Lanxi County was established in the eastern power grid of Heilongjiang Province and put into operation 14 November. This transmission line can solve the irrational power supply in the southern part of Mudanjiang Prefecture and save 130,000 kwh of electricity for the state each day. [Harbin Heilongjiang Provincial Service in Mandarin 1100 GMT 20 Nov 81 SK]

XINJIANG HYDROELECTRIC POWER DEVELOPMENT--Over the past few years, Xinjiang regional hydroelectric power building has quickly developed. At present, the installed capacity of all hydroelectric power stations throughout the region is 300,000 kw and their electricity output is 580 million volts, which are 109.8 percent and

56.7 percent more than in 1976 respectively. At present, some 83 percent of the counties in the whole region have built hydroelectric power stations and some 65 percent of the counties have regarded building of small hydroelectric power stations as the main task. Except Urumqi and Karamay municipalities, and Hami and Turfan prefectures, the agricultural and pastoral areas in all other places throughout the region are relying on hydroelectric power stations for the supply of electricity. [Urumqi Xinjiang Regional Service in Mandarin 1300 GMT 30 Oct 81 HK]

CSO: 4006/162F

NORTHEAST POWER MODIFICATION--The northeast power grid modified oil-consuming generator sets into coal-consuming ones and saved 368,000 tons of fuel oil in the past 9 months. Since 1979, oil-consuming generator sets with a capacity of 1.72 million kilowatts have been modified to use coal, saving 2.36 million tons of fuel oil and decreasing the total oil consumption by 40 percent as comapred to the period before the modification. [Shenyang Liaoning Provincial Service in Mandarin 1100 GMT 22 Oct 81 SK]

CSO: 4006/86F

HEILONGJIANG POWER PRODUCTION--As of 23 December, power departments in Heilongjiang Province had prefulfilled the annual power production plan. It is estimated that by the end of this year, an extra 300 million kwh of electricity will be produced. [Harbin Heilongjiang Provincial Service in Mandarin 2200 GMT 23 Dec 81 SK]

LIAONING ELECTRIC POWER--The Northeast Electrical Industrial Administrative Bureau, Liaoning Province, prefulfilled its annual production plan by 2 days. The water utilization rate among hydroelectric powerplants reached 99.3 percent. These powerplants overfulfilled the annual production plan by 2 billion kwh. [Shenyang Liaoning Provincial Service in Mandarin 1100 GMT 30 Dec 81 SK]

CSO: 4006/224F

ZHEJIANG-JIANGSU POWER LINE--Hangzhou, 28 Dec (XINHUA)--A new main power transmission line of the East China Power Grid, the second 220,000-volt high-tension transmission line from Huzhou, Zhejiang, to Changzhou, Jiangsu, was put into operation on 25 December. The new transmission line is 112 kilometers in length. [Beijing XINHUA Domestic Service in Chinese 1159 GMT 28 Dec 81 OW]

HUBEI ELECTRIC POWER GENERATION--The electric power departments of Hubei Province have fulfilled the year's generating plan 19 days ahead of schedule. Up to 12 December, the electric power stations had generated a total of 12.5 million watts. Since the beginning of this year, the electric power departments in all localities of the province have actively practiced the economic responsibility system and seriously improved the management system so as to ensure safety in production and generate more electricity. The electric power departments in all localities have adopted new measures to incessantly improve the transmission of electric power. The hydroelectricity stations have made full use of the abundant rainfall this year to generate more electricity. [Wuhan Hubei Provincial Service in Mandarin 1100 GMT 19 Dec 81 HK]

NEI MONGGOL POWER OUTPUT--Power departments of Nei Monggol Region produced 3.23 billion kwh of electricity by early December of 1981, overfulfilling the state plan by 10 percent. The industrial output value of power departments was 236 million yuan, and their profits were 42 million yuan in 1981. [Hohhot Nei Monggol Regional Service in Mandarin 1100 GMT 18 Jan 82 SK]

CSO: 4006/244F

HEILONGJIANG GENERATING UNITS--Harbin, 25 Dec (XINHUA)--Two thermal generating units, 200,000 kilowatts and 100,000 kilowatts respectively, began operation this month in Heilongjiang Province, according to the provincial power industrial department. Both units have been connected with the northeast China power grid. The 200,000-kilowatt unit, which started operation 18 December, was installed at the Uulan Ergi No. 2 power plant in Qiqihar City, the largest in the western part of the province. The plant itself is designed for three generating units with a combined capacity of 600,000 kilowatts. The other unit, which went into operation 6 December, was previously scheduled to begin operating in the first half of 1982. It was the second one installed at the No. 2 power plant in Mudanjiang City. The plant, which will have four generating units with a combined capacity of 400,000 kilowatts, put its first 100,000-kilowatt generating unit into operation in May. These two new units will help alleviate power shortages in the northeast China grid and the province itself, one of the country's major industrial and agricultural centers. [Text] [OW250932 Beijing XINHUA in English 0758 GMT 25 Dec 81]

CSO: 4020/60

SHANXI INCREASED POWER CAPACITY--Taiyuan, 11 Jan (XINHUA)--Shanxi Province, China's leading coal producer, has added 600,000 kilowatts to its power generating capacity in the last 3 years, bringing total power capacity to 2.58 million kilowatts, according to the Provincial Bureau of Power Industry. To accelerate the growth of power industry, efforts have been made to increase the capacity of Shanxi's existing power plants and their equipment. Some large power plants have been expanded and a number of new power plants have been built near coalmines. The Shanxi power grid provided 140 million kilowatt-hours of electricity in 2 months after it was connected with the Beijing-Tianjin-Tangshan power grid in September 1981. A 500-kilovolt power transmission line between Datong and Fangshan county under Beijing Municipality is being erected and will be connected with the Beijing-Tianjin-Tangshan power grid in 1984. The Niangziguan power plant is being expanded, and construction of the Zhangze Power Plant in eastern Shanxi is under way. [Beijing XINHUA in English 0255 GMT 11 Jan 82 OW]

CSO: 4020/84F

# CSEE NUCLEAR POWER SYMPOSIUM FOCUSES ON SAFETY STANDARDS

Beijing DIANLI JISHU [ELECTRIC POWER] in Chinese No 10, 5 Oct 81 pp 77-78

["The Chinese Society of Electrical Engineering Holds Academic Discussion Meeting on Nuclear Power in Suzhou"]

[Text] The Chinese Society of Electrical Engineering held an academic discussion meeting on nuclear power in Suzhou City from 29 June to 5 July 1981. This is the first special academic exchange meeting on nuclear power held during the 23 years since the founding of the Chinese Society of Electrical Engineering. The meeting also invited such units and leading agencies as the Chinese Nuclear Society, Chinese Geology Society, Chinese Seismology Society and related scientific and research organizations, design organizations and universities. A total of 79 scientific and technical workers attended the meeting. The meeting emphasized the question of selecting the plant site for nuclear power stations in academic exchange. It received a total of 30 academic reports and read 18 at the meeting. The meeting also conscientiously discussed the "draft of the temporary standards for the selection of plant sites of the pressurized water reactor nuclear power station" proposed by the Nuclear Power Science Institute of the Ministry of Electric Power, and proposed revisions. Participants at the meeting all believed that letting the society organize discussion and revise the standard or regulations is a good beginning.

In the opening remarks of the meeting, a brief summary of the process of understanding the development of nuclear power in our nation was presented. At present, we have gradually come to realize that it is necessary to use nuclear power as a supplement to the present hydraulic and thermal power generation of electricity and as a reserve for long-range energy technology. Previously, it was believed that the development of ar power was not urgent because of the following reasons:

(1) We believed that our nation had rich hydraulic resources and coal resources. Our nation has an equivalent of 680 million kilowatts of hydroelectric resources and there are over 600 billion tons of coal reserves. They are indeed plentiful. But when we made specific plans, we discovered problems. Over half of the hydroelectric resources are in the southwest. Coal is mostly found in Shanxi and Nei Monggol, its extraction and transportation are not easy. Therefore, in places like the northeast, eastern China and Guangdong, there is the need to develop nuclear power as a supplement to hydroelectric and thermal power.

(2) We believed that nuclear power construction would be too slow. Building a nuclear power station generally requires more than 7 or 8 years. Building a thermal power plant requires only 2 to 3 years. But if we consider the time to build the coal mines, it is not faster than building a nuclear power station. Thermal power generators producing 1 million kilowatts burns over 3 million tons of coal a year. Building a coal with an annual production of 3 million tons of coal also requires ten years. Building a large hydroelectric power station starting from the time of opening the roads also requires ten years.

(3) We believed that nuclear power stations are dangerous and they pollute. Actually, nuclear power technology has matured. Nuclear power stations are safe and clean. Of course strategically they must be conscientiously treated. The Three Mile Island Nuclear Power Plant incident of the United States did not cause one death nor personal injury.

(4) We believed that nuclear power stations are too expensive (this is the most important reason at present). Foreign nations have invested more in nuclear power stations than in thermal power plants, about 30 percent to 60 percent more. But nuclear fuel is inexpensive, therefore the cost of power generation by a nuclear power station is lower than a thermal power station. In the past, some people believed, investment in a nuclear power station is equivalent to investing in ten thermal power plants, this is the comparison of the cost of importing the first set of nuclear power equipment and the domestically built thermal power equipment. It is the comparison of calculated results of nuclear power with interest and depreciation of foreign currency against thermal power without considering these factors, thus causing a mistaken view. Imported equipment is more expensive but in the future we must build the equipment ourselves. The important thing is that after the nuclear power station has been built, the fuel cost is calculated at international market prices, thus using nuclear fuel for power generation can conserve coal or petroleum and this is very beneficial. The cost of nuclear fuel consumed to generate the same amount of electric power is only half that of coal and 1/6 that of oil. (The remaining coal or petroleum can be used to earn large amounts of foreign exchange).

At present, nuclear power technology is developing towards the fast neutron breeder reactor and nuclear fusion. The general trend in world energy is: the era of petroleum has almost passed, coal will once again rise and nuclear energy will become the major energy source. Although our nation's energy resources are plentiful, but per capita average is not that rich, falling behind many nations. Developing our nation's nuclear power is not only needed as a supplement to the present hydroelectric and thermal power, it should also be a long range national policy consideration.

The content of this meeting was rich. The content of the academic reports can be generally divided into three aspects: One aspect concerns special topics in the actual selection of plant sites in Guangdong, eastern China and Liaoning. The second aspect concerns special dissertation on seismic geology and environmental protection. The third concerns comprehensive discussion of the selection of sites for nuclear power stations.

Many reports received the attention of the participants. In geological seismology, one report concerned the safety island and explained the meaning and the criteria of evaluation of the "safety island", and suggested that regional stability surveys should first be carried out to find the "safety island" and then select the site. The reports on "migration of air-carried radioactivity released by nuclear enterprises into the atmospheric environment" and "probability calculations and the MFFTAP procedure for the melting of the reactor core of the pressurized water reactor nuclear power station" talked about the problem of environmental safety. The former described the two methods of calculations involving the continuous spreading and sedimentation of radioactivity being carried by winds after the radioactive gases enter the atmosphere. The latter used probability methods to derive the probability of melting of the reactor core and the computer's computational program. A comprehensive research report, "the selection of the site of nuclear power plants", described comprehensively and systematically the various conditions affecting the plant site. The world's nations all have their own corresponding demands for various conditions (including environmental impact, population density, meteorological conditions, ecology, cooling water sources, hydrology, geology, seismology, plant site geographic environment). The report believed (1) the nuclear power station has a problem related to radioactivity, therefore the requirements must be high. (2) Each nation's regulations are different because they are based on the different situations of each country. (3) The plant site to be selected must be considered from the points of view of safety, technology and economy and the sites must be repeatedly studied comprehensively and analyzed and evaluated. In addition, the Huadong Electric Power Design Academy, the Northeast Electric Power Design Academy, the Guangdong Electric Power Design Academy, the Guangdong Nuclear Power Station Preparatory Department, the Central Experimental Research Institute of the Hunan Provincial Electric Power Bureau also separately introduced the problems, experience and realizations encountered in the work of selecting sites for the nuclear power stations. They attracted the great interest of the participants. Everyone was concerned in particular about the progress of the stage of research of the feasibility of the Guangdong nuclear power station.

This meeting had a heavy academic atmosphere, the meeting was active and lively, and in the discussions, the following major problems were touched upon:

(1) Concerning the problem of the release of radioactivity into the surrounding environment when an accident occurs at the nuclear power station, the participating comrades unanimously agreed that the "draft standards" should carry out safety analysis of the nuclear power station according to the method of standard accidents included in the design. The believed that the analytical method of probability theory is theoretically more complete, but because of the lack of statistical data of actual operation of the facilities of the nuclear power station, it has not been officially accepted and used in actual construction by the world's countries advanced in nuclear power industry. But each country holds a different view as to which accident model should be used as the standard accident for inclusion in the design. For example, the United States rules that it should be considered on the basis of the accident of a loss of coolant of the reactor leading to melting of the core. Some other nations consider it on the basis of the accident of a loss of coolant of the reactor leading to the destruction of the shell of the fuel rods but not the melting of the core. This problem still requires further study and research.

(2) Concerning geological and seismic problems, the comrades held enthusiastic discussion on how to determine the designed seismic parameters. They proposed various opinions concerning the operation basis earthquake (OBE) and the safe shutdown earthquake (SSE) and their relationship to the basic intensity and the maximum possible earthquake. Some people believed these two parameters should be studied and determined together by engineering geologists and designers. Delegates to the conference discussed the problem of the conceptual and actual differences between the "dynamic rift" stipulated in the United States regulations and the "seismic rift" and "active rift" customarily used by our nation.

Concerning the gathering of data and the scope of surveying, everyone believed they should be determined by the geotectonics of the region of the site of the plant selected and suggested that a standard for geological and seismic surveys for nuclear power stations (or guidelines) should be organized and written early to stipulate in detail the items, content and depth of surveying work so that the work can follow a rule.

(3) Concerning flood prevention standards, the "draft standards" stipulated: "The ground elevation of the structures related to nuclear safety and inside the nuclear power station should be higher than the maximum flood water level." Everyone believed, the "elevation" affects both investment and operating costs greatly and must be seriously considered.

(4) Delegates attending the meeting believed, at present, it is very necessary to draw up the temporary standards for selecting the plant site of nuclear power plants at present. The "standards" drafted by the Nuclear Power Science Institute has added content to this meeting.

(Based on notes taken at the meeting by Chen Guanhua [7115 0385 5478])

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CSO: 4006/76

## ENERGY CONSERVATION PROMOTED ON VARIOUS FRONTS

### Guangdong's Third Energy Conservation Month

Guangzhou NANFANG RIBAO in Chinese 30 Oct 81 p 1

[Article: "Guangdong's Third 'Energy Conservation Month' Movement to be Launched in November"]

[Text] In accordance with the notice jointly circulated by the State Economic Commission and State Planning Commission concerning the fourth quarter energy conservation work and launching the third nationwide 'Save Energy Month' movement, the [Guangdong] Provincial Economic Commission, Planning Commission and Energy Sources Commission have decided to launch the third 'Energy Conservation Month' campaign in November this year throughout the entire province, stressing coordination with the arrangement for the fourth quarter energy conservation work with special emphasis on the following:

1. Further enhance supervision of energy conservation work; conduct extensive propaganda on the importance and urgency of conserving energy sources; mobilize the cadres and masses in the "Energy Conservation Month" drive. Based on energy conservation work summaries, praise advanced organizations and individuals. Set off a new high tide of energy conservation by the masses.

2. Fulfill and overfulfill this year's energy conservation targets by every possible means. All prefectures and departments must send people down to the enterprises and help the latter find means of reducing energy consumption as soon as possible.

3. In accordance with plans formulated at the energy conservation work conference recently organized by the Provincial Economic Commission and Energy Sources Commission for large/medium urban districts and heavy energy consumers throughout the province, the primary tasks and objectives of the fourth quarter energy conservation work are: Further improve the understanding of the importance of energy conservation work, make resolution to give up priority to energy conservation work. Strive to fulfill this year's energy conservation task by every possible means, save energy in order to increase production. Strive to increase the entire province's gross industrial output by 9 percent. On the basis of ensuring both quality and quantity, conduct energy balance tests among the enterprises in a planned way, and put real effort into the basics of energy sources management. Elevate energy rationing and

fixed quota management work to a new level. Focusing on energy conservation, speed up technical innovation of backward technical equipment and production technology. Remodel "energy guzzling" equipment in a planned way. Wherever feasible, gradually popularize heat and power plants, and central heating systems, so as to maximize energy conservation. Strive hard to complete projects using energy saving techniques enabling use of energy savers as soon as possible.

There is only a little over two months' time from now to the end of the year. In view of the pressing time and heavy task, the Provincial Economic Commission, Provincial Planning Commission and Provincial Energy Sources Commission are asking management people at all levels to keep sober-minded and develop fuller understanding of the current issue; they must raise the level of [political] consciousness, feel the urgency of saving energy, include energy conservation work in the major agenda, and achieve results through solid work during the third "Energy Conservation Month" campaign.

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CSO: 4006/112

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## 'Heat Treatment Center'

Shanghai JIEFANG RIBAO in Chinese 30 Oct 81 p 1

[Article by Ye Miaoxin [5509 5379 9515]: "Yangpu Ward Establishes 'Heat Treatment Center'"]

> [Text] Editor's note: The experience of the heat treatment "processing center" of Yangpu Ward is worth everyone's attention.
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> During the period of readjusting the national economy, and in breaking away from the limitations of the profession and in organizing specialized production, we must abolish the ideology of "large and complete" and "small and complete." After establishing the heat treatment "processing center" in Yangpu Ward, centralized production and uniform transfer were implemented. The utilization rate of the facilities increased, and the consumption of energy gradually dropped. It is killing many birds with one stone.
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> At present, there are many professions similar to heat treatment in the city that can join together and follow the road of specialized production. For example, there are plants that manufacture oxygen producing facilities, some only need oxygen in production with such gases as hydrogen being released, while other plants only need hydrogen in production with oxygen being released. If these plants can join together to establish an "oxygen manufacturing center" and implement specialized production, won't it then also be possible to kill many birds with one stone?

Under the organization of the leading group of heat treatment specialization in Yangpu Ward, a heat treatment processing center has been established by the Shanghai Annealing Plant, Machine Tool Plant, Electrical Meters Plant and Optical Instruments Plant. The center broke with barriers of the profession and contracted for the task of heat treatment processing for nearby plants. At present, 20 factories hand over products for the center to process and have shut down all their own heat treatment facilities. This not only conserves over 500,000 kilowatt-hours of electricity each year, it also increases the quality of heat treatment processing. This measure has created a new step in readjustment of the economy and in energy conservation.

Yangpu Ward has over 100 factories with heat treatment processing facilities. Among them, the rate of utilization of the facilities at over 50 factories is only about 25 percent, they are frequently shut down and started up and a lot of electric power is wasted. The consumption of electricity for heat treatment of each ton of products at some plants is 4 to 5 times higher than that at specialized plants. Also, the technical strength of these plants is weaker, and the quality of processing is unstable.

The first group of four factories, the Shanghai Annealing Plant etc., selected by the leading group of heat treatment specialization in Yangpu Ward are relatively stronger technically in heat processing and their facilities and conditions are better. These four plants were used to establish the heat treatment processing center and to be in charge of the processing task for the factories in the Yangpu Ward. The plants with products for heat treatment can choose any one of the four factories of the "processing center" and sign an agreement for processing. At present, 20 factories in the Yangpu Ward have signed agreements with the "processing center" and a group of factories are in the process of negotiating with them.

The emergence of the "processing center" has led heat processing towards specialized production and over the past six months, visible results have been achieved. The delivery time and quality which are the two things that each factory seeking the service is most concerned about have all been satisfactorily solved. Now, the member factories of the "processing center" can deliver rush jobs in three days and ordinary products in six days and complicated products in 9 days. They also strive towards further shortening the time. After specialized production, technical superiority has developed, and the quality of the products has improved. The hand wrecking ball manufactured by the Shanghai Crane Accessories Plant is sold in 56 countries. Because of the backward annealing technology of the plant, only about 50 percent of the high strength chains have passed quality inspection. This July, the plant handed this product over to the Shanghai Annealing Plant for processing and the percentage passing quality inspection has increased to above 90 percent, strengthening the product's competitive ability.

Specialized production has opened a new path for conserving energy. Because the "processing center" arranges production centrally, the rate of utilization of the facilities is high, and consumption of electricity is gradually dropping. For example, the Shanghai Machine Tool Plant originally required 745 kilowatt-hours of electricity for heat treatment of one ton of products, now this has dropped to

706 kilowatt-hours. If the more than 50 factories with a relatively low rate of utilization of heat treatment facilities of Yangpu Ward can shut down their own facilities and let the "processing center" process the products, over 3 million kilowatt-hours of electricity can be conserved a year.

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## Coal Conservation Awards, Penalties

Nanjing XINHUA RIBAO in Chinese 28 Nov 81 p 2

[Article: "Instituting a System of Economic Rewards and Penalties to Promote Coal Conservation"]

[Text] The Xuzhou Prefecture fuel department has adopted economic measures, including awards for conservation and increased prices or penalties for overconsumption, to deal with industrial coal supply, and is applying them down to the enterprise and individual levels, thus promoting coal conservation work throughout the prefecture. In the first 10 months of this year, total industrial output value for the prefecture was up by 11.1 percent from the same period last year, and industrial coal consumption had decreased by 5.6 percent, so that increased output and conservation of coal were achieved simultaneously.

The Suzhou Prefecture fuel department first used the method of authenticated fixed-amount supply in dealing with the 460 plants in the prefecture, and this year it also instituted such economic measures as preferential supply and a system of awards and penalties. To institute preferential supply, the department issues preferential supply certificates to major coal users who met coal consumption standards; if their coal consumption exceeds the targets for 3 months running, these certificates are recalled. For a number of years the Tongshan Ceramics Plant had given considerable attention to coal conservation work and was relatively advanced among the plants in that industry in the prefecture. But after the spring festival this year, the management by the plant leadership slackened, and coal cinders with a high carbon content were hauled from the plant without classification and recycling, resulting in serious waste. In June, a survey by the fuel department discovered the situation, and the plant was penalized by a decrease in supply and a temporary stoppage of supply. The plant immediately made a series of improvements, decreasing coal consumption per ton of ceramic by an average of 0.15 tons compared with last year, and in most cases the carbon content of coal cinders leaving the plant was decreased to the specified level of 10 percent or less. In the first 3 months of this year the Juning Alcoholic Beverages Factory's coal consumption per ton of alcoholic beverages produced was more than 620 kilograms above quota, and in April the fuel department decided to increase the coal charges to the plant by 50 percent. The plant leadership immediately found specific methods of decreasing coal consumption, and the consumption levels were quickly brought down to 158 kg below the norm.

Collectives and individuals with coal conservation achievements receive commendations and awards, and those wasting coal are penalized. In the first third of November, relevant units in the prefecture and the various county fuel departments carried out surveys and criticism of 102 enterprises in the prefecture, with the result that 8 enterprises' coal consumption was found to be lower than standards, and the party secretary and the responsible plant director, department head and shop superintendent of each received awards totaling 160 yuan. Two plants were found to have coal consumption above the norms and were fined; the party secretary and the responsible plant director, department head and shop superintendent of each paid fines totaling 100 yuan. Some 33 units received awards for having a coal cinder carbon content lower than 10 percent for three months running; each of the boiler engineers of these plants was awarded a bonus of 20 yuan. Some 21 units were found to have coal cinder carbon content between 10 and 15 percent, and the boiler engineers of each of these paid a fine of 2 yuan. Five units were found to have coal cinder carbon content exceeding 15 percent, and were penalized a total of 2 yuan for every 5 percent above norm.

The use of economic measures related to coal supply has effectively promoted coal conservation in industry. Many plants not only have made an energetic effort in coal-use management, but have also made an effort in boiler modernization and improvement and have been using low caloric value fuels. The Feng County alcoholic beverage plant used the "reverse combustion" method and decreased its coal consumption by more than 30 percent; this method has already been spread in Feng County and is gradually being spread in other counties as well. Xuzhou Prefecture has a coal waste rock storage area that holds 100 million tons and takes up more than 30,000 mu of good agricultural land; in order to make thorough use of this energy resource, some cement, building materials and chemical engineering plants have made large-scale use of the waste rock. The Pi County catering services Company and the Tongshan Foodstuffs Plant produce food products using a coal waste rock far infrared drying oven, which offers the advantages of conservation of coal, decreased pollution, improved product quality and higher labor productivity; this method is being spread in the prefecture.

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## Economic Measures in Coal Conservation

Nanjing XINHUA RIBAO in Chinese 28 Nov 81 p 2

[Editorial: "Use of Clearly-Defined Awards and Fines Will Assure Energy Conservation"]

[Text] At present, many industrial enterprises lack a complete system of strict regulations regarding coal use, and management is lax or haphazard. Some major coal consumers are on the "one big rice pot" system, responsibilities are ill-defined, and rewards and penalties are not made clear. In their eagerness to achieve good output value or output volume, some plant leaders do not concern themselves with coal consumption and give no thought to achieving better economic results by using less coal. Some plant leaders believe that the main thing is to protect the enterprise and the products, and that the higher levels will keep the coal coming; they consider coal conservation as not worth thinking about. Ideological education should be intensified and the importance of coal conservation propagandized in these enterprises, and in addition the necessary economic measures should be used to make them rapidly overcome this energy-wasting state of affairs.

The experience of the Xuzhou Prefecture fuel supply department demonstrates that implementation of a series of awards and fines is extremely effective in coal conservation. Like other types of economic work, coal use and coal management should involve clear economic responsibility and should be tied to the economic interests of the enterprise and the individual employees. When coal conservation is carried out effectively, not only does the state benefit, but the enterprise and the individual employees also gain. If they are careless and wasteful of precious coal, the enterprise and the individuals should be penalized, paying a certain compensation fee. This will help stimulate enterprise and employee enthusiasm for thrifty use of coal.

In order to operate the coal use economic responsibility system effectively, thorough, detailed surveys should be conducted, average advanced coal consumption norms for various products and processes should be drawn up, coal should be supplied and awards and penalties determined on the basis of quotas, and economic measures involving supply limitations, decreased supply or increased prices for excessive users should be established. In coal distribution and supply, the principles of priority supply and rational use should be resolutely adhered to, and priority supply should be accorded to enterprises which have low coal consumption, good product quality and good product marketability.

Effective coal management and conservation are critical to the major concern of maintaining a certain rate of development of this province's national economy. Leaders at all levels and all cadres and workers must raise their consciousness, intensify leadership, and implement measures to assure that coal consumption per unit product output is decreased as rapidly as possible and that increases in both coal conservation and output are achieved.

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CSO: 4006/229

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## Power Industry Conservation

Chengdu SICHUAN RIBAO in Chinese 4 Nov 81 p 1

[Article by Wang Tong [3769 1749]: "Energy Conservation by the Provincial Power Industry System Achieves Visible Results"]

[Text] The broad number of workers of our province's electric power industry bureau system conscientiously implemented the guideline of the State Council concerning energy conservation work, concentrated on the basic work in energy conservation, insisted on economic management of the power grid, actively carried out technical innovations, and the achievements in energy conservation have been visible. From January to September, the amount of consumption of standard coal to generate one kilowatt-hour of electricity by thermal power generation was less than that of the same period by 1 gram, conserving a total of 5,782 tons of standard coal. The power line loss was lower by 0.35 percent than the same period last year, conserving 35,470,000 kilowatt-hours of electricity. The Shizitan Hydroelectric Power Station fully utilized hydroelectric resources and generated 200 million kilowatt-hours of hydroelectric power more than the same period last year. These total a conservation of over 100,000 tons of standard coal.

Since the beginning of this year, the Provincial Electric Power Industry Bureau further established and made sound energy conservation agencies, strengthened leadership in energy conservation, implemented organizational measures in energy conservation, and organized forces to go the basic levels to carry out surveys and research and inspection and encouragement. While carrying out the general survey of thermal energy utilization, thermodynamic balance and thermal efficiency tests were conducted for each generator and the internal energy conservation indices of power generating and power supply units were examined and evaluated and compared.

To do the work of energy conservation well, the electric power bureau insisted on implementing management for economic operation of the power grid. They started out from the maximum economic gain of the whole network, carried out uniform management and control in production, transmission and distribution of electric power so that operation was made as safe as possible, the cycles were up to standard, the advantages of high efficiency and low energy consumption of the high temperature and high voltage generators were developed actively, thus the percentage of electricity generation by the high temperature and high voltage generators in the whole power network reached 60.87 percent, conserving 3,339 tons of standard coal. At the same time, some technical reforms of the power network were carried out, and problems of circuitous supply of electric power were solved, and the loss of electrical energy was reduced. From January to September of this year, 5 projects to raise voltage were restructured and transformer capacity increased by 224,500 kilovolt-amperes.

This bureau also actively launched social energy conservation work. They helped users to establish quotas for unit consumption of electricity, implemented energy conservation measures and popularized advanced electric power conservation techniques and realized good results. At present, the broad number of workers of the power system are actively entering the third "energy conservation month" activities, further stressing basic work in energy conservation, actively rebuilding outdated equipment, using many ways to conserve 1 gram of coal, one kilowatt-hour of electricity, and making every effort to complete--with surplus--the whole year's production plan.

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CSO: 4006/123

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## Rolling Mill Conserves Water, Power

Beijing GUANGMING RIBAO in Chinese 29 Dec 81 p 2

[Text] How can a large consumer of water and energy save water and electrical power? According to the experience of Beijing Rolling Mill No 2, attention should be given to developing science and technology to exploit all possibility of reconstruction.

The Beijing Rolling Mill No 2 is a medium sized enterprise producing ordinary carbon steel materials. It is the largest consumer of water in Beijing City. Just for cooling, the 4 steel rolling shops of the plant use up 7,700 tons of water a day. This water is used once only before it is discharged to become wastewater to pollute the environment. In Sep 1980, the plant raised its own capital, organized its engineers, cadres, and workers, and designed and built a water storage tank of a capacity of 5,700 $m^3$ and a drainage ditch measuring more than 1,000 m in length to form a circulating water system. The water used in the cooling process can be precipitated in the tank and used again and again to reach a rate of cyclic utilization of 92 percent. In this manner, the plant pumps 5,300 tons less of water every day from the underground water resource. Each year, 1.93 million tons of water is saved and the state saves 38,690 yuan. The capital investment of the entire circulating water system may be regained in 5.5 years.

The No 4 and No 5 rolling machines are operated by 2,630 kw asynchronous electric motors. Due to low efficiency operation, the motors are frequently in idle position to waste a great deal of electricity. With the help of the Electric Machinery Teaching and Research Group of Qinghua University, the Motive Power Department reconstructed the electric motors after several years of research. A new form of 2-phases joined in a series and one phase in a short connection is adopted for the 3-phase rotor group to realize synchronization of the asynchronous motor having an impact negative load. The reconstruction will reduce 3.67 million kwh of non-work-producing power a year. The power use efficiency of the entire plant will thus be raised 9.7 percent to result in a cost saving of 40 thousand yuan. Moreover, the voltage of the power network will also be stabilized to result in an improved operating condition for the motors of other steel rolling mills.

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CSO: 4006/207

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## Transportation Sector to Stress Fuel Conservation

Hangzhou ZHEJIANG RIBAO in Chinese 3 Nov 81 p 1

[Article: "Motor Vehicle Fuel Conservation Meeting Jointly Convened in Hangzhou by Transportation Ministry and China Highway Society Sets New Demands for Stepping up Fuel Conservation Work in Scale and Depth"]

[Text] During the third nationwide energy conservation campaign, the Ministry of Transportation and the China Highway Society jointly sponsored a motor transport fuel conservation conference which included exchanging experiences and academic discussions. It was proposed that the fuel conservation effort be enhanced both in scale and depth and thus elevated to a new level.

Over the past few years, the Ministry of Transportation has attained tremendous achievements in the conservation of motor transport fuel; the average fuel consumption has been falling annually, and a number of advanced organizations and drivers have emerged in the fuel conservation drive. The conference focused on exchanging advanced experiences in fuel conservation. Over ten companies, including the Zhejiang Province Motor Transport Company and Shandong Province's Qingdao Long Distance Motor Transport Company introduced how to strengthen management and cut down fuel consumption; some ten-odd experts and technicians presented theses and reports on fuel supply management and technical innovation. The conference will play an important role in promoting future fuel conservation work.

The conference participants also studied current problems in fuel conservation, such as disequilibrium, lack of in-depth and solid work, etc.. For instance, the fuel consumption rate of cargo trucks per thousand ton kilometers is only 63 metric liters in advanced provinces, 87 liters in average cases, and over 100 liters in poor cases. The fuel consumption rate of passenger vehicles per thousand tons kilometer is only 24 liters in advanced provinces, 28 liters in average cases, and over 33 liters in poor cases. The potentiality lies in the differences. In order to raise fuel conservation work to a new level, the conference urged motor transport organizations at all levels to stress the following points in the future:

1. Earnestly strengthen ideological and political work to help everyone understand the difficult and protracted nature of fuel conservation work, further heighten their consciousness in fuel conservation and create a favorable atmosphere in which fuel saving is honored and fuel wasting is disgraced, thus helping to elevate fuel conservation work to a new level. As the Ministry of Transportation is a major consumer of finished fuels, the results of its fuel conservation work bears direct influence on the conservation of finished fuel throughout the whole country. With the development of traffic and communication, plus the increasing number of specialized motor transport vehicles, fuel conservation will become the chief means of meeting the demands for fuel. Leaders at all levels must summon up their energy, probe deeper into practical problems, conduct investigation and study, enhance leadership, overcome the lax in morale, redouble their efforts, adopt more effective measures, and step up fuel conservation in depth and scale.

2. Further enhance basic management, and bring about scientific and systematic way of working in every aspect of work. At present, quote a few enterprises are comparatively weak in the basic work of fuel management. All links in fuel work, i.e., from fuel storaging, metering and management to distribution, lack accurate and complete primary records; the route charts and fuel management of motor transport vehicles are not in order; there is lack of stringent inspection; some parts of information are missing and the fuel conservation figures are not real at all. All enterprises and organizations must do solid basic work by straightening enterprises first and enhancing the system of job responsibility in economics; to straighten things out, they should initiate the practise of checking wastes, checking leaks, and checking management work; they should set up sound rules for regulating various projects, thus conducting management work in a scientific and systematic way.

3. Step up scientific research, generate fuel through technical innovations. At present, quite a few organizations use motor vehicles of all descriptions and in poor condition. Based on the actual situation of quite a number of cities and provinces, in order to cut down fuel consumption, it is very realistic to undertake remodelling of vehicles and popularization of new fuel conservation techniques. All organizations are urged to take positive steps towards the remodelling of great mileage and heavy fuel consuming vehicles. Departing from the practical situation and adapting measures to suit local conditions, they must strive to remodel all vehicles which are worth remodelling within two or three years.

The Ministry of Transportation should also take the initiative in providing the society with technical innovation services to support the remodelling of motor vehicles.

4. Launch an extensive, in-depth and protracted campaign for fuel conservation among the masses. Over the past few years, all kinds of fuel conservation activities have been initiated everywhere, and a certain amount of results have been achieved. Leaders at various levels and concerned organizations should strengthen organization leadership and technical guidance in this aspect. In line with local conditions, they should come up with more experiences in organizing effective fuel conservation competitions. Advanced organizations and individuals should be commended and rewarded.

At the conference, Pan Qi [3382 3825], the Minister of Transportation and Chairman of the China Highway Society, delivered a speech.

The Conference unanimously endorsed a proposal to call on every motor vehicle organization in the country to join the fuel conservation competition.

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CSO: 4006/133

## Energy-Saving Products

Beijing GUANGMING RIBAO in Chinese 24 Dec 81 p 1

[Text] In the past 2 years, the first machine industry system designed, made, and reconstructed 109 power-saving electrical machines, including industrial boilers, medium and small electrical machines, windmills, small hydroelectric generators, petroleum drilling machines used to exploit energy resources, and equipment for washing, selecting, and processing coal. Some of these new products have already been in production.

According to statistics, of the 27 thousand electrical machine products of the plants belonging to the first machine industry system, more than 3 thousand are low efficiency, high energy consumption, and bulky products. It has been estimated that these machines are consuming 35 percent of the total national coal production, 61 percent of electrical power, and 90 percent of petroleum fuel. For this reason, the first machine system listed these products as targets for renewal and reconstruction.

China has 200 thousand industrial boilers, but most of them are inefficient and consume a great deal of coal. Since last year, the First Ministry of Machines has organized 17 boiler plants of the country to design and experiment jointly 17 formulas of making new boilers suitable for medium quality coal. When these new boilers are in operation the average heat efficiency of industrial boilers of the entire country will be raised 2 percent. For the purpose of fully utilizing China's abundant low quality heat energy resources, such as peat and bone coal, the First Ministry of Machines has also tried to design 52 industrial boilers using low quality fuel. To date, 32 boiler plants in Guangzhou, Shanghai, Chengdu, Harbin, etc have produced more than 1,400 such boilers, which have created the condition for utilizing low grade fuel.

Presently, China has close to one million trucks. In order to reduce oil consumption, the First Ministry of Machines has proceeded to improve the engine of the Jianfang trucks to raise the original 95 horsepower to 115 horsepower while reducing 13 percent of the original oil consumption and increasing the speed 10 km/hours. This type of improved engines are now in production in batches. The First Ministry of Machines has also been trying to improve the carburetor, seals, etc. of cars and the research on designing a new type energy-saving car, including small passenger-automobiles has begun.

The first machine industry system has also designed for rural villages a group of 2 types of small hydroelectric power generators of less than 5 kw in capacity. The efficiency of these generators is 1 to 2 percent higher than similar products made in the past.

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CSO: 4006/208

## Guangdong Energy Conservation Efforts

Guangzhou NANFANG RIBAO in Chinese 27 Dec 81 p 1

[Article: "Solid, Excellent Results in the Province's Energy Conservation Work for This Year"]

[Text] This year our province implemented the Central Committee's and State Council's directives regarding the readjustment policy and conservation of energy; energy conservation work has achieved excellent results and it is expected that the total year's conservation figures will be 450,000 tons of coal, 22,000 tons of coke, 32,000 tons of fuel oil, 45,000 tons of refined petroleum products and 140 million kilowatt-hours of electricity.

The inadequate energy supply is a weak link in this province's industrial production. As a result, this year leadership personnel at all levels in the province have laid great stress on energy conservation and have approached it as an important measure for completion of this year's production assignments. For example, Foshan city organized a special energy conservation group, divided into coal, oil and electricity teams, to make spot surveys of 20 major energy consumers through the city and to spread new energy conservation techniques. In addition the Foshan Prefecture economic committee held a prefectural on-the-spot experience-exchange conference on energy conservation techniques in Zhongshan County to spread such new electricity conservation techniques as Taishan and Zhongshan Counties' far infrared drying of materials and alumosilicate fiber insulation, capacitive nonreactive compensators for transformers, conversion of AC switches to noiseless DC operation, and automatic no-load shutoff of electric welding devices.

All departments in all prefectures have also devoted particular attention this year to effective basic work in energy conservation management; they have set up energy conservation management machinery to deal with the main users and have put it into good working order, have made sure that complete sets of measuring equipment and instruments are available, have carried out continual energy utilization surveys and heat balance measurements, and have instituted target-oriented management and energy conservation awards.

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CSO: 4006/229

## Sichuan Conservation Work

Chengdu SICHUAN RIBAO in Chinese 4 Nov 81 p 1

[Article by staff reporter Zhang Liquan [1728 0448 3123]: "Emphasize Energy Conservation Work; Exert Efforts to Complete This Year's Energy Conservation Plan"]

[Excerpts] The leading group of energy conservation of the provincial people's government, the provincial planning committee and the provincial economic committee held a discussion meeting on 28 October to study and plan for launching the third "energy conservation month" activities in each department and each locality this November. It asked the leadership at each level to emphasize this work, to do a good job of the third "energy conservation month" activities, to seek energy from strengthening business management and in technological innovations, to make vigorous efforts to complete this year's energy conservation plan, and to prepare well for next year's further development of energy conservation.

The leading comrades of the provincial level bureaus (departments), the provincial scientific association, the provincial workers' union and the Chengdu city economic committee participated in this discussion meeting. The leading comrades of the Provincial Metallurgical Bureau, the Chemical Industry Bureau, the Electric Power Bureau and the Chengdu city economic committee separately introduced the status of energy conservation work launched this year and the achievements.

Total consumption showed a declining trend. For example, the metallurgical bureau system launched a general survey of energy consumption, established regulations for energy management, popularized some advanced energy conservation techniques, and paid attention to retrieving surplus heat. Each steel mill's energy consumption index generally dropped. The subordinate enterprises of the provincial chemical industry bureau conserved a total amount of energy equivalent to 170,000 tons of standard coal during the first 9 months of this year because the unit consumption of energy for major products dropped. The subordinate enterprises of the provincial electric power bureau expanded the utilization of water conservancy resources, and hydroelectric power output was 200 million kilowatt-hours more than the same period last year, equivalent to conserving 87,000 tons of standard coal.

As comrades participating in the discussion meeting also pointed out, there is still great potential for energy conservation throughout the province. But the leadership of some departments and enterprises still do not have a sufficient understanding of the significance of energy conservation. Basic management work has still not caught up, and some necessary energy conservation systems have not been established or implemented. All these hinder better development of energy conservation. Everyone hoped that launching the third "energy conservation month" activities can push forward the solving of the above problems.

What work should be stressed in the province's third "energy conservation month" activities? The concerned leading comrades of the province proposed: 1. Carry out ideological education in energy conservation for the broad number of cadres, workers and masses around the "several concrete demands concerning the conservation of energy in the industrial and mining enterprises and in cities" proposed by the

State Planning Commission, the State Economic Commission, the State Energy Commission and around the implementation of the emergency notice from the provincial people's government concerning the installation of the "three meters" (electricity meters, water meters, gas meters) [to monitor] domestic energy consumption.
2. The concerned bureaus (departments at the provincial level and each locality and each enterprise must make appropriate arrangements in light of their own energy consumption characteristics. In particular, clear demands must be proposed for some directly subordinate enterprises and large users of coal, electricity and gas regarding how to do a good job of "energy conservation month" activities.
3. We must organize our forces and carry out an examination of the situation and energy conservation measures.

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## Zhangzhou Conservation Measures

Nanjing XINHUA RIBAO in Chinese 28 Nov 81 p 2

[Article: "Changzhou Industries Save Coal and Increase Output"]

[Text] In the process of readjustment of the national economy, the Changzhou City industrial departments are treating energy conservation and increasing output as a major task. In January-October of this year the city's total industrial output value was up by 10.7 percent from the same period last year, while total energy consumption was down 1.7 percent from the same period last year.

At the beginning of this year, Changzhou City industrial department made a survey based on the state-assigned energy plan and calculated that if industrial output was maintained at the 1980 level this year, only 70 percent of the coal requirement, 58 percent of the oil requirement and 80 percent of the electrical requirements could be met, while the production capacity for running water could satisfy only 60 percent of domestic and production needs. The workers and cadres of Changzhou became aroused and made an all-out effort, adopting a series of approaches and measures aimed at achieving increased output with conservation of energy. The main methods were as follows. First, energy management was strengthened and economic responsibility was instituted. The fuel standards for 274 products citywide and the electrical consumption standards for 100 products were revised, the approach of "a fixed quota for the year, quarter-by-quarter planning, and contracting for use" was adopted for oil consumption, and awards for conservation and fines for overconsumption were instituted. Second, stress was laid on technical training and scientific use of energy. The city not only trained management cadres and operating personnel, but taught energy conservation as part of three training courses for plant directors and enterprise managers. Many enterprises organized technical classes for boiler engineers, electrical engineers and drivers to improve their energy use standards. Third, process equipment was improved and attempts were made to get the most out of equipment. Deadlines for improvement of products and improvement or shutting down of equipment that consumed too much energy were established throughout the city, with the result that energy consumption was brought within state norms. Fourth, new energy conservation techniques were popularized and thorough use was made of waste heat and exhaust gases. This year, 30 energy saving technologies or good methods such as infrared-heated driers, alumosilicate insulation, sawdust fitter packing and the like were spread throughout the city. The Changzhou coke and gas plant initially discharged its coking gases into the air, which wasted energy and polluted the sourroundings. Now it has installed a gas storage tank and laid a gas pipeline, and the coke gas is fed to 1,500 households for domestic use, yielding a saving of 1,500 tons of coal, in addition to which excess coal gas is supplied to the nearby Qinye Plastics Plant as a boiler fuel, which has saved more than 1,000 tons of coal, thus yielding the triple result of conservation, economic results and improved environmental cleanliness.

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## Briefs

SHANDONG ENERGY CONSERVATION--Shandong Province has scored achievements in conserving energy through renovating boilers, sealing up surplus vehicles and readjusting the industrial structure and product mix. The provincial industrial output value has increased 2.63 percent, while energy consumption decreased 3.14 percent compared with the corresponding 1980 period. According to incomplete statistics, the province has saved 989,600 tons of coal, 11,800 tons of coke, 15,600 fuel oil and 280 million kwh of electricity. [Jinan Shandong Provincial Service in Mandarin 2300 GMT 24 Nov 81 SK]

SAVING ENERGY IN XINJIANG--From January to September this year, the industrial and communications enterprises in Xinjiang region achieved remarkable results in saving energy. According to incomplete statistics, by the end of September, the region had saved 113,000 tons of raw coal, 92 million kilowatt-hours of electricity and 35,000 tons of crude oil and finished oil each. [Urumqi Xinjiang Regional Service in Mandarin 1300 GMT 31 Oct 81 HK]

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HUNAN ENERGY CONSERVATION--Since the beginning of this year, Hunan provincial industries, mines and enterprises have scored good results in saving energy. In the first 9 months of this year, the province saved 590,000 tons of coal and 135 million kilowatts of electricity and 25,800 tons of oil, and it is estimated that it will overfulfill the state's quota set for saving energy. In carrying out energy saving, all localities, departments and enterprises have publicized the significance of saving energy and perfected the structure for saving energy. Management over saving energy has been strengthened and various measures have been adopted and as a result, the past practice of "eating out of the same pot" has been changed. According to statistics of relevant departments, 50 percent of the enterprises in the province have saved energy. From January to November, the province increased its total industrial output by 3.5 percent despite the fact that energy used was 2 percent less than the previous year. [Changsha Hunan Provincial Service in Mandarin 2310 GMT 9 Dec 81 HK]

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QINGHAI ENERGY CONSERVATION--Qinghai Province has scored relatively good achievements in saving energy sources this year. According to statistics, the province is expected to save 120,000 tons of coal, 16,000 tons of fuel oil and 10 million kwh of electricity this year. [Xining Qinghai Provincial Service in Mandarin 2330 GMT 24 Dec 81 SK]

PLA ENERGY SAVING--Beijing, 8 Jan (XINHUA)--Various PLA units achieved good results in energy saving in 1981. Though the supply of oil was reduced by 20 percent in 1981, the whole army saved over 140,000 tons of oil, reduced consumption of electricity by 30 percent and saved nearly 140,000 tons of coal for cooking. Energy-saving leading groups were set up in various units, measures were taken and efforts made to promote energy saving. Energy-saving organs were set up in all units under the Beijing PLA units in 1981. [Beijing XINHUA Domestic Service in Chinese 0130 GMT 8 Jan 82 OW]

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QINGDAO ENERGY CONSERVATION--Qingdao Municipality, in Shandong Province, increased its industrial output by 3.68 percent in terms of value in the first 10 months of 1981 over the corresponding 1980 period, but consumption of coal, power and water dropped from 6.4 to 14.1 percent from the same 1980 period. The city saved 171,500 tons of coal, 58.5 million kwh of electricity and 7.9 million tons of water. At the same time, the Shengli oilfield, in Shandong Province, has continued to popularize new techniques for conserving energy. By the end of October, the oilfield had conserved 48,800 tons of crude oil, 11.5 million kwh of electricity and 12.5 million cubic meters of natural gas. [Jinan Shandong Provincial Service in Mandarin 2330 GMT 8 Dec 81 SK]

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